Computer Clones
Automatic Video Game/TV Antenna Switching
How To Print Computer Graphics

Polish Your Apple with a Luminance Board

This Issue: Shar-Trac Tracking Turntable
Integrated Stereo Amplifier
Teknika 15 Color TV Monitor
Says who? Says ANSI.
Specifically, subcommittee X3B8 of the American National Standards Institute (ANSI) says so. The fact is all Elephant floppies meet or exceed the specs required to meet or exceed all their standards.

But just who is "subcommittee X3B8" to issue such pronouncements?
They’re a group of people representing a large, well-balanced cross section of disciplines—from academia, government agencies, and the computer industry. People from places like IBM, Hewlett-Packard, 3M, Lawrence Livermore Labs, The U.S. Department of Defense, Honeywell and The Association of Computer Programmers and Analysts. In short, it's a bunch of high-caliber nitpickers whose mission, it seems, in order to make better disks for consumers, is also to make life miserable for everyone in the disk-making business.

How? By gathering together periodically (often, one suspects, under the full moon) to concoct more and more rules to increase the quality of flexible disks. Their most recent rule book runs over 20 single-spaced pages—listing, and insisting upon—hundreds upon hundreds of standards a disk must meet in order to be blessed by ANSI. (And thereby be taken seriously by people who take disks seriously.)

In fact, if you'd like a copy of this formidable document, for free, just let us know and we'll send you one. Because once you know what it takes to make an Elephant for ANSI . . . We think you'll want us to make some Elephants for you.

ELEPHANT.™ HEAVY DUTY DISKS.

For a free poster-size portrait of our powerful pachyderm, please write us.
Distributed Exclusively by Leading Edge Products, Inc., 225 Turnpike Street, Canton, Massachusetts 02021
Call: toll-free 1-800-343-6833; or in Massachusetts call collect (617) 828-8150. Telex 951-624.
## APPLICATION PROGRAMS

<table>
<thead>
<tr>
<th>Model</th>
<th>Name</th>
<th>Mfr. Sugg. Retail</th>
<th>Elek-Tek Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHD</td>
<td>Basic+</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PCE</td>
<td>(4 BASICs)</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PMO</td>
<td>Price Match Optimization</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHF</td>
<td>Finance Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHB</td>
<td>Business Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHD</td>
<td>Development Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PCE</td>
<td>(5 BASICs)</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PMO</td>
<td>Price Match Optimization</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHF</td>
<td>Finance Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHB</td>
<td>Business Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHD</td>
<td>Development Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
</tbody>
</table>

## SOFTWARE LIBRARIES

<table>
<thead>
<tr>
<th>Model</th>
<th>Name</th>
<th>Mfr. Sugg. Retail</th>
<th>Elek-Tek Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PST</td>
<td>Texas Instruments Library</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PSL</td>
<td>Library Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PDQ</td>
<td>Data Processing Library</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PPS</td>
<td>Programming Support System</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PMS</td>
<td>Programming Management System</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PST</td>
<td>Texas Instruments Library</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PSL</td>
<td>Library Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PDQ</td>
<td>Data Processing Library</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PPS</td>
<td>Programming Support System</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PMS</td>
<td>Programming Management System</td>
<td>24.95</td>
<td>24.00</td>
</tr>
</tbody>
</table>

## INFORMATION DISCOUNTS

<table>
<thead>
<tr>
<th>Model</th>
<th>Name</th>
<th>Mfr. Sugg. Retail</th>
<th>Elek-Tek Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHD</td>
<td>Basic+</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PCE</td>
<td>(4 BASICs)</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PMO</td>
<td>Price Match Optimization</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHF</td>
<td>Finance Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHB</td>
<td>Business Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHD</td>
<td>Development Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PCE</td>
<td>(5 BASICs)</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PMO</td>
<td>Price Match Optimization</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHF</td>
<td>Finance Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHB</td>
<td>Business Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
<tr>
<td>PHD</td>
<td>Development Programming Package</td>
<td>24.95</td>
<td>24.00</td>
</tr>
</tbody>
</table>

## ELEK-TEK, INC.

6557 N. Lincoln Ave., Chicago, IL 60645
(312) 877-7866

November 1982

**CALL TOLL FREE 800-621-1298**

**ELEK-TEK MERCHANTISSE IS BRAND NEW. FIRST QUALITY AND COMPLETE.**
Tek's most successful scope series ever: At $1200-$1450, it's easy to see why!

Wide-range vertical sensitivity: Scale factors from 100 V/div (10X probe) to 2 mV/div (1X probe). Accurate to ±3%. Ac or dc coupling.

Two high-sensitivity channels: dc to 60 MHz bandwidth from 10 V/div to 20 mV/div; extended sensitivity of 2 mV/div at > 50 MHz.

Sweep speeds: from 0.5 s to 50 ns. To 5 ns/div with X10 magnification.

Delayed sweep measurements: Accurate to ±3% with single time-base 2213; to ±1.5% with dual time-base 2215.

Complete trigger system. Includes TV field, normal, vertical mode, and automatic; internal, external and line sources; variable holdoff.

Probes included. High-performance, positive attachment 10-14 pF and 60 MHz at the probe tip.

In 30 years of Tektronix oscilloscope leadership, no other scopes have recorded the immediate popular appeal of the Tek 2200 Series. The Tek 2213 and 2215 are unapproachable for the performance and reliability they offer at a surprisingly affordable price.

There's no compromise with Tektronix quality: The low cost is the result of a new design concept that cut mechanical parts by 65%. Cut cabling by 90%. Virtually eliminated board electrical connectors. And obviated the usual cooling fan.

Yet performance is written all over the front panels. There's the bandwidth for digital and analog circuits. The sensitivity for low signal measurements. The sweep speeds for fast logic families. And delayed sweep for fast, accurate timing measurements.

The cost: $1200* for the 2213. $1450* for the dual time base 2215.

*Price F.O.B. Beaverton, OR. Price subject to change.

You can order, or obtain more information, through the Tektronix National Marketing Center, where technical personnel can answer your questions and expedite delivery. Your direct order includes probes, operating manuals, 15-day return policy and full Tektronix warranty.

For quantity purchases, please contact your local Tektronix sales representative.

ORDER TOLL FREE
1-800-426-2200
Ask for Department 10242
In the state of Washington, Call (206) 253-5353 collect.

Tektronix
COMMITTED TO EXCELLENCE

Copyright ©1982 Tektronix, Inc. All rights reserved. 136-1
FEATURE ARTICLES

COMPUTER CLONES/Stan Veit 64
A comparison of computer variations to their originals.

PRINTING COMPUTER GRAPHICS/Stan Veit 79
How to use high-resolution graphics software plus a review of packages available.

THE 68000/Hunter Scales 96
A powerful 16-bit microprocessor chip with many applications.

THE 3" VS. 3 1/2" MINIFLOPPY BATTLE/Les Solomon 94
Sony's 3 1/2" and Amdek's 3" disks against the standard floppies.

CONSTRUCTION ARTICLES

POLISH YOUR APPLE WITH A LUMINANCE BOARD/Ray Dahlby 42
Add-on board generates 16 shades of color or black/gray on video screen.

STILL USING A "MODEL T" TV/GAME ANTENNA SWITCH?/Gary Kloesz 53
An electronic circuit switches from a TV antenna input to video game or computer and back.

BUILD THE MAIL-BOX SENTRY/Les Svoboda 76
LED and tone indicators announce mail arrival.

EQUIPMENT REVIEWS

TEKNIKA ATV-M19 19" COLOR TV MONITOR 14

TECHNICS MODEL SL-5 LINEAR TRACKING TURNTABLE 26

McINTOSH MODEL MA6200 INTEGRATED STEREO AMPLIFIER 40

COLUMNS

LES SOLOMON ON COMPUTER HARDWARE 22

STAN VEIT ON COMPUTER SOFTWARE 24

COMPUTER HOTLINE/Stan Veit 102

SOLID-STATE DEVELOPMENTS/Forrest M. Mims 104
A Universal Active Filter Breakthrough.

COMPUTER BITS/Carl Warren 108
Notes on Using Your System as a Secretary.

EXPERIMENTER'S CORNER/Forrest M. Mims 111

PROJECT OF THE MONTH/Forrest M. Mims 124
Homemade pressure Sensitive Resistor.

DX LISTENING/Glenn Hauser 120

DEPARTMENTS

EDITORIAL/Art Salsberg 4

LETTERS 6

NEW PRODUCTS 10

ELECTRONICS LIBRARY 101

OPERATION ASSIST 116

ADVERTISER'S INDEX 117

COVER ART BY JAMES HEGEDUS
The typical reader of COMPUTERS & ELECTRONICS has a host of electronics interests, with microcomputers fast becoming a staple for avocational, business, and professional purposes. A survey of subscribers conducted last year confirmed again that the great majority of our readers are male (97%); well-educated (7 of 10 attended college and 17% have had post-graduate study); and involved with more than one electronics activity (usually it amounts to three or four).

The study revealed that more readers plan to become active in the microcomputer area within the year than in any other electronics activity. Considering this fact, it is not surprising then to learn from the survey that, from among subscribers who plan to purchase a consumer electronic product in the next 12 months, microcomputers rank first with 20% (followed by video cassette recorders with 17%). In giving purchasing advice to others, advice on microcomputers ranked second (with 20%) only to audio equipment (21% gave advice).

Experimenting with electronics is, naturally, at the forefront of our readers' interests, whether it be microcomputers, audio, video, or a home electronics gadget. In this respect, I'm eagerly following Forrest Mims's three-part column on experimenting with Kodak's new disc camera, which starts in this issue. Forrest tells me that the applications resulting from his electronic modification work on the camera are among the most exciting work he's ever done. The final result of his efforts is expected to appear in our January 1983 issue.

One issue before that, in December, we'll present a modestly priced universal speech synthesizer project. It will let any computer talk back to you—or anyone else. Meanwhile, talk to you next month.

Art Salsberg
TIMEX INTRODUCES
THE POWER OF THE COMPUTER
FOR JUST $99.95*
Turn your TV into a time-sharing videotex display for $399.*

Now you can connect your family to the informative and entertaining world of CompuServe, The Source, Dow Jones News/Retrieval and other time-sharing and data-base networks.

All you need is the RCA VP-3501 Videotex Data Terminal (with built-in modem and RF modulator), your telephone and your TV set. You can get instant access to regional newspapers and newsletters...weather reports and sports results...computer games and more. You can use the VP-3501 to make airline reservations...find restaurant recommendations in cities around the world. Plus stock market and corporate data. Or access your school or business computer. You can even send electronic mail and buy products.

In addition to information retrieval, the VP-3501 provides full interactive communications with a host computer. What you have working for you is a versatile, feature-packed interactive data terminal which can be worth far more to you than its low price. Its unique color-locking circuitry gives you sharp color graphics and rainbow-free characters. You get 20- and 40-character formats in one of eight foreground colors and separate color backgrounds.

With reverse video, you can emphasize certain letters, words, or sentences. A built-in tone generator...plus a white noise generator...let you create everything from the sound of explosions to the sound of music. The spill-proof, easy-to-clean keyboard is highly suitable for hostile environments. And its membrane key switches give you a natural feel.

The VP-3501 is truly a fine Videotex Data Terminal. And don't forget, it's made by RCA...the first name in television...now the foremost name in videotex terminals.

See a demonstration at your computer or electronics dealer, or contact RCA. Order now and you'll get a free password and a free hour's time-sharing on both CompuServe and Dow Jones News/Retrieval! (Limited time offer.)

For more information or to order, call toll-free, 800-233-0094. (In Pennsylvania, call 717-393-0446.) Visa or MasterCard orders accepted by phone. Or send a check including $3.00 delivery charge plus your local sales tax to RCA MicroComputer Products, New Holland Avenue, Lancaster, PA 17604.

*Suggested User Price.
If you own a Timex-Sinclair 1000 or ZX81 computer, you should have a Memopak behind it. From increased memory to high resolution graphics, Memotech has a Memopak to boost your system’s capabilities. Every Memopak peripheral comes in a black anodised aluminium case and is designed to fit together in “piggy back” fashion to enable you to continue to add on and still keep an integrated system look.

Order at no risk
All Memotech products carry our 10 day money back guarantee. If you're not completely satisfied, return it in ten days and we will give you a full refund. And every Memotech product comes with a six month warranty. Should anything be defective with your Memopak, return it to us and we will repair or replace it free of charge. Dealer inquiries welcome. To order any Memotech product call our toll-free number 800/662-0949 or use the order coupon.

MEMOTECH CORPORATION
7550 West Yale Avenue
Denver, Colorado 80227
Phone: (303) 986-1516
TWX: 910-320-2917

Memopak 64K RAM The 64K RAM extends the memory of your Sinclair by 56K to a full 64K. It is directly addressable, user transparent, is neither switched nor paged and accepts such BASIC commands as 10 DIM A (6000). The Memopak 64K turns your Sinclair into a powerful computer suitable for business, recreational and educational use. No additional power supply is required.

Memopak 32K RAM The 32K RAM offers your Sinclair a full 32K of directly addressable RAM. Like the 64K Memopak, it is neither switched nor paged and enables you to execute sophisticated programs and store large data bases. It is also fully compatible with Sinclair's or Memotech's 16K RAM to give you a full 48K of RAM.

Memopak 16K RAM The Memopak 16K RAM provides an economical way to increase the capabilities of your Sinclair. And at the same time, it enables you to continue to add on other features with its “piggy back” connectors. It is compatible with the Sinclair 16K or a second Memopak 16K or Memopak 32K to give 32K or 48K of RAM respectively.

Memopak High Resolution Graphics The Memopak HRG contains a 2K EPROM monitor and is fully programmable for high resolution graphics. The HRG provides for up to 192 by 248 pixel resolution.

Memopak Printer Interface The Memopak Centronics Parallel or RS232 Interface pads enable your Sinclair to use a wide range of compatible printers (major manufacturers’ printers available through Memotech at significant savings). The resident software in the units gives the ASCII set of characters. Both Memopak printer interfaces provide lower case character capabilities. The RS232 Interface is also compatible with modems.

New products coming soon Memotech will soon be introducing four new Sinclair compatible products: a high quality, direct connection keyboard, a digitizing tablet, a 16K EPROM and a disk drive. Watch for our future advertisements.
**The Software:**

**Programs**

**Comshare Target Software**

**Master Planner**

MASTER PLANNER is the ultimate in electronic spreadsheet packages offering just about everything you can get on a huge, expensive main frame planning system. Made to interact with WORDSTAR.

8" CP/M

LIST PRICE: 325.00

MH PRICE: 279.00

**Mathstar**

MATHEMAGIC uses your computer as an advanced calculator allowing you to do sophisticated functions, memory locations, and much more.

8" CP/M

LIST PRICE: 99.00

MH PRICE: 79.00

**Graphmagic**

GRAPHMAGIC creates pie charts, bar graphs, line graphs, and scatter charts from different spreadsheet programs including MATHEMAGIC, SUPERCALC, and VISICALC®.

LIST PRICE: 99.00

MH PRICE: 79.00

**Eagle Software**

**Money Decisions**

This program provides information to evaluate common managerial and financial decisions. MONEY DECISIONS will solve specific problems including investments, loans, management and depreciation schedules. Simple enough to be used by managers without computer skills.

8" CP/M

LIST PRICE: 199.00

MH PRICE: 149.00

**Denver Software**

**Easy**

EASY EXECUTIVE ACCOUNTING SYSTEMS for IBM is an easy to learn system that generates complete financial and management reports including accounts receivable, accounts payable, and general ledger.

8" CP/M

LIST PRICE: 149.00

MH PRICE: 639.00

**Microsoft**

**Multiplan**

MULTIPLAN is a completely interactive electronic worksheet featuring a giant worksheet that's 63 columns wide by 255 rows deep. It provides multiple "windows" to other areas of the worksheet which allow you to see how changing a number or formula in one area will affect another area of the worksheet.

8" CP/M

LIST PRICE: 275.00

MH PRICE: 249.00

**Oasis Software**

**Wordplus**

WORDPLUS not only finds spelling errors but helps you locate the proper spelling by consulting a dictionary and then makes the correction on your document.

8" CP/M

LIST PRICE: 149.00

MH PRICE: 149.00

---

**LOCATIONS**

1444 Linden Street P.O. Box 498, Bethlehem, PA 18016

Complete lines of Hardware and Software
<table>
<thead>
<tr>
<th>MH-</th>
<th>Software</th>
<th>CP/M</th>
<th>Microhouse Price</th>
<th>Apple</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WORDSTAR®/MAILMERGE</td>
<td>645.00</td>
<td>319.00</td>
<td>500.00</td>
</tr>
<tr>
<td>4</td>
<td>WORDSTAR® MATHSTAR</td>
<td>620.00</td>
<td>369.00</td>
<td>500.00</td>
</tr>
<tr>
<td>5</td>
<td>dBASE II/WORDSTAR/MAILMERGE</td>
<td>1345.00</td>
<td>819.00</td>
<td>1200.00</td>
</tr>
<tr>
<td>7</td>
<td>dBASE II/QUICKCODE/dUTIL</td>
<td>1070.00</td>
<td>749.00</td>
<td>1070.00</td>
</tr>
<tr>
<td>8</td>
<td>WORDSTAR® / MASTERPLANNER</td>
<td>820.00</td>
<td>549.00</td>
<td>700.00</td>
</tr>
<tr>
<td>9</td>
<td>SMARTMODEM/CROSSTALK</td>
<td>378.00</td>
<td>325.00</td>
<td>378.00</td>
</tr>
<tr>
<td>10</td>
<td>QUICKSCREEN/MBASIC</td>
<td>544.00</td>
<td>389.00</td>
<td>389.00</td>
</tr>
</tbody>
</table>

**MICROLINE:**

MICROHOUSE offers 24 hour computer shopping with MICROLINE. Microline is a computerized order-entry system that enables you to access specific information on over 1000 microcomputing products supplies and accessories. MICROLINE operates at 300 BAUD, 8 BITS, NO PARITY, 1 STOP BIT. MICROHOUSE will process your order within 24 hours.

**1-215-868-1230**

All items subject to availability. Prices and specifications subject to change without notice.

Call Toll Free **1-800-523-9511**

In PA **1-215-868-8219**

MICROHOUSE

The Microcomputer People
NEW PRODUCTS

VIDEO CAMERA WITH TIME-LAPSE SETTING

The VC-X2 from Akai has an "intervalometer" that serves as a time-lapse device capable of recording periods from 8 hours to 11 days. The camera uses the new Saticon tube, said to be superior to a vidicon tube in resistance to burning (after-images when a camera is moved from a bright scene to a dim one) and effectiveness in low light situations. A 1.5" black-and-white monitor is built into the unit for in-field viewing and playback. Automatic features of the VC-X2 include auto focusing, motorized two-speed telephoto with 6:1 zoom, macro setting, audio fade-in/fade-out for both audio (via a standard boom microphone) and video. A second mike jack permits recording in stereo. Resolution is given at 300 lines. Weight is 5.3 lb. $1195.

Circle No. 100 on Free Information Card

MINI DRILL/STAND

The PD-3 portable hand drill from OK Machine and Tool Corp. is especially useful for pc-board drilling. It runs at 2500 rpm on four "AA" batteries and weighs 10.6 oz with batteries. The collet accepts drills from 0.019" to 0.58" diam. Together with OK's STD-50 stand, designed especially for the PD-3, it can be used like a drill press to increase precision.

Circle No. 99 on Free Information Card

I/O EXPANSION

The MH89 plus 3 accessory to the Heath/Zenith H89 and H90 computers is reported to double I/O expansion capability. It replaces the right-hand accessory board area with a 6-slot mother board, creating three additional slots. The latter having four device-select lines each, separately port-addressed on 8-byte boundaries. Current draw is 50 mA. $150.

Circle No. 98 on Free Information Card

VIC-20 DEVELOPMENT SYSTEM

The Gloucester Computer Bus Co. has introduced the Promqueen Cartridge, designed to provide EPROM programming capability for the Commodore VIC-20 computer. All necessary connections are made when it is plugged into the VIC's extension port. The Promqueen uses 4K bytes of RAM for program testing before burning them in on the EPROM. A Mimic switch permits an external computer to access programs from a Promqueen RAM or to transmit its own programs to the Promqueen, so the VIC keyboard can be used as part of a development system. A switch determines which of the four VIC expansion blocks is occupied by the Promqueen, so the Promqueen RAM can be used either for direct memory expansion or in conjunction with other cartridges. A switch sets the unit for either 2716 or 1732 EPROMs. Software for storing BASIC programs is included. $170.

Circle No. 97 on Free Information Card

Additional information on new products covered in this section is available from the manufacturers. Either circle the item's code number on the Free Information Card or write to the manufacturer at the address given.
STEREO-SOUND VCR
The new Marantz Model VR 200 Beta VCR combines stereo audio capability with Dolby C and Beta Noise Reduction. In addition, the unit has a separate audio input that permits taping of FM simulcast while the video section records the picture on the same tape. Other features include gold-plated connectors for corrosion resistance and improved signal quality, light-touch solenoid controls, LED signal-level indicators, full-function remote control (wired), automatic or manual record levels, 5-event/14-day programmable timer, audio dubbing, freeze frame, 9X Betascan in forward or reverse, quartz-lock speed control, automatic tape rewind, slow-motion playback, and stereo headphone jack. $1295.

Circle No. 96 on Free Information Card

TWO-CHANNEL DIGITAL MULTIMETER
The ac-powered WD-753 is a dual-input, auto-ranging, auto-zero DMM with a 3½-digit LED display. The display shows numeric value plus limit of measurements selected. The dual input provides "A" and "B" channels pre-programmed by the user for either ac or dc volts or amps, or low- or high-power ohms. Each channel can be monitored independently, even while a different measurement is being made by the other channel. Ranges are volts from 200 mV to 1000 V dc or 750 V ac; ac and dc current from 200 mA to 2 A; and resistance from 200 ohms to 20 megohms. Basic dc accuracy is rated at 0.1%. Dimensions are 3½" H X 8½" W X 10" D. Weight is 4 lb. $385. VIZ Mfg. Co.

Circle No. 94 on Free Information Card

LOW-COST CASSETTE DECK
The front-loading V-33 from Teac is metal-compatible and has Dolby-B noise reduction with an additional Brilliance switch to boost higher frequencies. It features a 12-segment LED-bar level indicator, 3-digit tape counter, and record muting to eliminate commercials. Frequency response is rated at 30 to 16,000 Hz with either metal or CrO2 tape, from 30 to 15,000 Hz with ferric tape. S/N is rated at 57 dB before applying noise reduction and increases by 10 dB above 5000 Hz with Dolby B. Wow and flutter is given as 0.05%. $210.

Circle No. 95 on Free Information Card

PORTABLE PRINTING DATA TERMINAL
Radio Shack's TRS-80 PT-210 portable printing data terminal has a full typewriter keyboard, thermal printer, and 110-300-baud acoustic telephone coupler. It can generate 99 ASCII codes, including 67 printable characters, 32 terminal control characters, and digits via a switch-selectable keypad. Operation can be half or full duplex, with odd, even, or no-parity modes. The thermal printer uses a 35-element matrix and offers variable contrast control. Each 8" line can include up to 80 characters and carriage return is automatic at the 81st column. Printing speed is 50 cps, with 6 lines per vertical inch. Indicators include a 14-s tone, a power-on lamp, and carrier-detect and character-error lamps. It is housed in a silver-grey case 13½" x 14½" x 5"; weight is 15 lb with paper. Price is $995; optional RS232C interface plug-in module is $70.

Circle No. 93 on Free Information Card

SUPERHET RADAR DETECTOR
Electrolet's Fuzzbuster uses phase-lock circuitry that reportedly picks up all bands and types of radar, including low-power and pulse. It has a highway/city selector, a light to signal that contact with radar has been made, and an alarm panel to indicate distance from the radar source by sequentially lighting a row of LEDs as the vehicle nears the radar. Audio warning trigger is set by adjusting an on-off control. $300.

Circle No. 92 on Free Information Card

November 1982
**SOFTWARE for the IBM PC**

**BUSINESS**

<table>
<thead>
<tr>
<th>LIST</th>
<th>OUR PRICE</th>
<th>PRICE</th>
<th>NEW</th>
<th>CALL available on</th>
<th>CALL</th>
<th>CALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASH/TON, Executive II</td>
<td>$125</td>
<td>568</td>
<td>595</td>
<td>126</td>
<td>245</td>
<td>395</td>
</tr>
<tr>
<td>CODEMAINE, Target Planner</td>
<td>$175</td>
<td>459</td>
<td>459</td>
<td>175</td>
<td>350</td>
<td>600</td>
</tr>
<tr>
<td>DENVER SOFTWARE, Easy Executive Accounting System</td>
<td>$725</td>
<td>540</td>
<td>540</td>
<td>725</td>
<td>1450</td>
<td>2900</td>
</tr>
<tr>
<td>ENGLISH, Accounting (Version 1.1)</td>
<td>$175</td>
<td>350</td>
<td>350</td>
<td>175</td>
<td>650</td>
<td>1300</td>
</tr>
<tr>
<td>ESSAY Canvas (KDF 10)</td>
<td>$495</td>
<td>595</td>
<td>595</td>
<td>495</td>
<td>1195</td>
<td>2390</td>
</tr>
<tr>
<td>IBIS, Note Stack (DH)</td>
<td>$125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>IMPACT SOFTWARE, 1.9.6 for DH</td>
<td>$495</td>
<td>495</td>
<td>495</td>
<td>495</td>
<td>990</td>
<td>1980</td>
</tr>
<tr>
<td>INNOVATIVE, Sales Manager</td>
<td>$125</td>
<td>250</td>
<td>250</td>
<td>125</td>
<td>450</td>
<td>900</td>
</tr>
<tr>
<td>MICROSOFT, WordStarTM plus free WordStar Training Manual</td>
<td>$495</td>
<td>495</td>
<td>495</td>
<td>495</td>
<td>990</td>
<td>1980</td>
</tr>
<tr>
<td>PERFECT SOFTWARE, Perfect Writer TM</td>
<td>$188</td>
<td>188</td>
<td>188</td>
<td>188</td>
<td>375</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>Perfect Writer TM</td>
<td>$188</td>
<td>188</td>
<td>188</td>
<td>188</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>Perfect Writer TM</td>
<td>$188</td>
<td>188</td>
<td>188</td>
<td>188</td>
<td>375</td>
</tr>
<tr>
<td>SELECT INFO, Select a WPS</td>
<td>$195</td>
<td>395</td>
<td>395</td>
<td>195</td>
<td>795</td>
<td>1590</td>
</tr>
<tr>
<td>SORCIN, Super Write, call for availability</td>
<td>$250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>500</td>
<td>1000</td>
</tr>
</tbody>
</table>

**UTILITY**

<table>
<thead>
<tr>
<th>LIST</th>
<th>OUR PRICE</th>
<th>PRICE</th>
<th>NEW</th>
<th>CALL available on</th>
<th>CALL</th>
<th>CALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NACSY, Copy/PC Backup Copy &amp; Utilities</td>
<td>$15</td>
<td>25</td>
<td>25</td>
<td>15</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>MOBEL DATA, * System Software, Bit Coder</td>
<td>$30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>60</td>
<td>120</td>
</tr>
</tbody>
</table>

---

**HARDWARE for the IBM PC**

<table>
<thead>
<tr>
<th>LIST</th>
<th>OUR PRICE</th>
<th>PRICE</th>
<th>NEW</th>
<th>CALL available on</th>
<th>CALL</th>
<th>CALL</th>
</tr>
</thead>
</table>

---

**PRINTERs, Impact**

<table>
<thead>
<tr>
<th>LIST</th>
<th>OUR PRICE</th>
<th>PRICE</th>
<th>NEW</th>
<th>CALL available on</th>
<th>CALL</th>
<th>CALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFS. Printc 1220 Color w/Graphic</td>
<td>$495</td>
<td>495</td>
<td>495</td>
<td>495</td>
<td>990</td>
<td>1980</td>
</tr>
<tr>
<td>MXD 12/10 with Graphic</td>
<td>$495</td>
<td>495</td>
<td>495</td>
<td>495</td>
<td>990</td>
<td>1980</td>
</tr>
<tr>
<td>IBM PC to Epson Cable</td>
<td>$40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>Apple Interface and Cable for MX80 or MX100</td>
<td>$125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>Apple Interface for Epson</td>
<td>$79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>158</td>
<td>316</td>
</tr>
<tr>
<td>IBM 650 with Epson Printer</td>
<td>$30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Other cables, interfaces, ribbon, heater and paper in stock</td>
<td>$30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>60</td>
<td>120</td>
</tr>
</tbody>
</table>

---

**COMMODORE**

**VE-20**

<table>
<thead>
<tr>
<th>LIST</th>
<th>OUR PRICE</th>
<th>PRICE</th>
<th>NEW</th>
<th>CALL available on</th>
<th>CALL</th>
<th>CALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIC 20 Home Computer</td>
<td>$325</td>
<td>599</td>
<td>599</td>
<td>325</td>
<td>658</td>
<td>1316</td>
</tr>
</tbody>
</table>

---

**DISKETTES**

**Control Data Corporation 12 for IBM Special, Limited Time**

<table>
<thead>
<tr>
<th>LIST</th>
<th>OUR PRICE</th>
<th>PRICE</th>
<th>NEW</th>
<th>CALL available on</th>
<th>CALL</th>
<th>CALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 each</td>
<td>$460</td>
<td>460</td>
<td>460</td>
<td>460</td>
<td>920</td>
<td>1840</td>
</tr>
<tr>
<td>125 each</td>
<td>$40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>500 each</td>
<td>$219</td>
<td>219</td>
<td>219</td>
<td>219</td>
<td>438</td>
<td>876</td>
</tr>
<tr>
<td>1000 each</td>
<td>$125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>250</td>
<td>500</td>
</tr>
</tbody>
</table>

---

**ORDERING INFORMATION AND TERMS**

*We accept CODs and credit cards. Orders cancellable within 30 days of ordering. All prices subject to change and are subject to change. All sales are final. We are not responsible for any mistakes in pricing or availability.**
T E K N I K A Electronics Corp. has been distributing electronic products produced by the Japanese manufacturing giant, the General Corporation, for about five years. The company was a leader in this country with a component TV system, which features an optional TV/FM tuner stereo amplifier as well as the separately available 19" video monitor reviewed here. Like other "component" TV systems, one must use a TV tuner to get TV stations; a video cassette recorder can be used for this purpose, as well as an optional tuner such as offered by Teknika and others.

Whereas the Sony "Profeel" video monitor examined in our September 1982 issue has a built-in stereo amplifier, the Teknika Model ATV-M19 is the subject of this review and does not incorporate audio amplifiers. There is a significant difference in the price of this 19" model and the highly rated Sony 19" model, though. While the Teknika monitor has a suggested retail price of $599, the Sony has a suggested price tag of $850. To provide a good buying perspective, we will be comparing the two monitors while detailing our findings on the Teknika.

**General Description.** This unit uses a familiar type of color picture tube. It's a 90°-deflection, three-gun, in-line, slotted-mask, quick-start tube that requires no dynamic convergence adjustments. Housed in an attractive 20½" × 18½" × 18" cabinet that has a brushed silver metallic front and weighing 55 lb, the Teknika monitor is slightly smaller and 17 lb lighter than its Sony counterpart. The Teknika monitor has a solid-state design of course, using two ICs, 23 transistors, 29 diodes, 2 thermistors, and a crystal. Most of these components are mounted on a single, horizontal board located just below the picture tube. A separate board contains video output transistors in the usual arrangement at the socket of the color CRT. All of the adjustment controls are located behind a hinged front panel just below the screen, similar to the arrangement used by Sony.

When we review the schematic diagram, however, the difference between the two units becomes apparent. Teknika uses a transformerless power supply with a switching regulator circuit that carefully regulates the 115-V bus, which then goes to the horizontal flyback transformer. All other voltages (+12V +180V, and +750V) are derived from the horizontal flyback. In the Sony KX1901, separate power transformers, providing complete power-line isolation, are used for all major B+ voltages.

The Teknika converter transformer uses a ferrite core and three windings. Output of the 60 Hz bridge rectifier goes through the

---

**Switching power supply circuit of Teknika ATV-M19 video monitor.**
Our "almost wholesale" prices just got 2% lower. Take an additional 2% off our listed prices, until December 24.

The following vendors and products are available at our "almost wholesale" prices:

**SOFTCARD PREMIUM SYSTEM**
**NEC**
**COMREX-CR1 PARALLEL**
**486**

**ANADEO**
**STAR RAIDERS**
**ATARI 410 PROGRAM**
**DISK BANK PROTECTOR**
**5 1/4"**

**F-10 40 KEYPAD**
**10. 16**

**Hazardine TELEVIDEO 7728A**
**APPLE BOARDS**
**APPLE CLOCK**
**AMDEK 5126 W/ 256K**
**IBM SNAPSHOT**

**HASZLERINE**
**NEC 1000-1500**
**DISK DRIVE**

**APPLE HARDWARE**
**SUPER K I**
**VERSA WRITER DIGITIZER**

**TRAC-80 HARDWARE**
**PERCOM Q/A SEPARATOR**
**PERCOM OUDOS W/ COS 3.4**
**TANSON 80 TIM DISC DRIVE W/ F.345**
**LIVX DISK DRIVER W/DSU 3.3**
**MOD 8 TIM DRIVE**

**MICROSOFT APPLE**
**MAC CIRCULARS**
**2-80 SOFTCARDS**

**IBM HARDWARE**
**SEATTLE 516 RAM**
**516 MEMORY UPGRADE**

**MONITORS**
**AMBER 12**
**NEC 12 GREEN MONITOR**
**SANYO 12 MONITOR**
**SANYO 12 COLOR MONITOR**

**MOUNTAIN HARDWARE**
**CPS MULTIFUNCTION BOARD**

**CALIF. COMPUTER SYSTEMS**
**APPLEBOARDS**

**MODEMS**
**NAVIGATION MAC ACOUSTIC WIND**
**NAVIGATION AUTO-CAL ANS.**
**NAVIGATION AUTO-CAL ANS.**
**NAVIGATION AUTO-CAL ANS.**

**TERMINALS**
**TELEVISED TV**
**TELEVISED TV**

**MICRO PRO APPLE CPI**
**WORKSTAR I**

**APPLE GAMES**

**BRODERUBBER**
**APPLE FAMICOM**

**AUTOMATED SIMULATIONS**
**TEMPEST OF APSAN**
**NASHEIRE WARRIOR**
**STAR WARRIOR**

**CRUSH CRUMBLE AND DUMP**

**MUSE SOFTWARE**
**ROBYN INARI**
**THREE MILE ISLAND**

**CRUNCH SOFTWARE**
**FIBER INK**
**CELSION**

**SIRIUS SOFTWARE**
**SQUARES**
**SHEKERS**

**EDUCATIONAL SIMULATION**
**EPA**
**BEER RUN**

**EDUWARE**
**COMPLT-WTH ANIMATIC**

**MORE GREAT APP...**
**APLICOMPUTER**
**THE SHATTERED ALLIANCE**

**ATI**
**ULTIMA**
**MASTER LOCKER**

**EDUCATIONAL COMPUTER**
**COMPTIA**
**TANSON 80**

**APPLE NEWWARE**

**IBO SOFTWARE**
**VINTAGE**

**TO ORDER OR FOR INFORMATION CALL (213) 706-3353**

**Modem order line: (213) 883-8976**

We guarantee everything we sell for 30 days — no returns after 30 days. Defective software will be replaced free, but all other software returns are subject to 15% restocking fee and must be accompanied by RMA with a written RMA number. Shipping charges are: $3 for all prepaid orders, actual shipping charges for non-prep: $3 for COD orders under $100; $5 for over $100 plus $1 for every 25 dollars, plus 15% for foreign and 4% for APAC and CFP. We accept Visa, Mastercard, and American Express. Prices quoted are for stock on hand and subject to change without notice.
New from NRI!
The first at-home training in
videocassette recorder repair
with exclusive videotaped lessons.

Learn TV/Audio/Video Servicing...
includes state-of-the-art VCR, NRI Action Video lessons,
plus full training in color TV and audio repair.

Now, you can learn the hottest,
most wanted skill in home entertainment
electronics...servicing and repairing
videocassette recorders and video disc
players. Well over 2 million units have
already been sold and the demand is just
starting! Already, qualified VCR techni-
cians are in short supply...people are
waiting up to a month for VCR repair.
Good jobs at good pay are going beg-
ging. And NRI can get you in on the
action with convenient and effective
at-home training.

Choice of
Specialized Training
NRI offers you three Master Courses
in TV/Audio/Video Servicing, each com-
plete, each with equipment and training
State-of-the-Art VCR
This modern VCR features high-technology design with electronic pushbutton tuning, remote control, three recording speeds with up to 6-hour capacity, high-speed visual search, built-in clock/timer, memory rewind and audio dubbing capability. Direct drive motors and azimuth recording give outstanding picture reproduction.

It's yours to keep, as part of your training. You'll not only use it to learn operation and servicing techniques, but to play the absorbing NRI Action Video lessons that come as part of your specialized training. In word and picture, you'll learn theory, construction, and service procedures, see them explained in graphic closeups. And you get this unique training only with NRI!

Learn at Home at Your Convenience
No need to quit your job or tie up your evenings at night school. No time away from your family or expensive travel. NRI comes to you. You are a class of one, getting both theory and practical hands-on training backed up by our staff of experienced educators.

NRI the Pros' Choice
More than 67 years and a million and a half students later, NRI is still the first choice in home-study schools. A national survey of successful TV repairmen shows that more than half have had home-study training, and among them, it's NRI 3 to 1 over any other school.

That's because you can't beat the training and you can't beat the value. Only NRI combines exclusive fast-track training techniques with modern state-of-the-art equipment to give you the skills you need for success quickly and easily. Only NRI offers such complete training with so many timely options for specialized bench experience. Send for our free catalog and get all the facts on these exciting Master Courses in TV/Audio/Video servicing.

Free Catalog...
No Salesman Will Call
Mail the coupon today for your free copy of our 100-page look into tomorrow. It shows all the equipment you get, describes each lesson in detail. And it tells you about other important career opportunities in Microcomputers and Microprocessors, Digital and Communications Electronics, Electronic Design

Specialized training on Heath/Zenith Model 2501 25" (diagonal) color TV, videocassette recorder, or AM/FM stereo you keep for yourself.

for the specialty you want. Each course thoroughly prepares you for color TV plus audio and video equipment. Then, you take the specialized hands-on training on the equipment you select.

You can get specialized audio experience as you build your own AM/FM stereo system complete with speakers. Or gain real bench experience with hands-on TV training as you build a 25" (diagonal) fully computerized, programmable color TV and professional test instruments. Or train with your own RCA videocassette recorder and NRI's exclusive Action Video servicing lessons on videotape.

Other NRI courses include microcomputers, communications electronics, electronic design, industrial electronics.

Technology, and more. Send today and get started on a big new future for yourself. If card has been removed, please write to us.

NRI SCHOOLS
McGraw-Hill Continuing Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016
1-112
We'll give you tomorrow.
center winding to the collector of transistor Q504. With its base connected to the primary winding, Q504 generates the necessary oscillations, which are then amplified by power driver Q503. Regulation is provided by the combination of Q501 and the op amp on IC501, developed by the output of D511 in combination with the reference voltage. This reference is based on the two series zener diodes, D503 and D509.

The third winding generates the high-frequency signal to rectifier D512 and the pi-filter consisting of C512, L503, and C513. Note that only small values of L and C are required owing to the high frequency involved.

It is interesting to observe that the Teknika service manual urges the technician to measure power-line leakage from the unit as well as to perform a special resistance test. The leakage test measures ac from any exposed metal surface to the ground of the power line, and specifies less than 0.5 mA. In addition, a resistance test is recommended in which the resistance between the jumpered ac plug’s prongs and any metal part (such as the screws of the antenna terminal) should be no less than 1.0 megohms and no more than 5.2 megohms, with the ac switch on or off. In this respect, the Teknika video monitor may be slightly better than most color TV receivers, but, unlike the Sony KX1901, it is not completely isolated from ground.

A single 75-ohm phone jack is available for the 1-V p-p composite video input to the Teknika video monitor. This presents quite a contrast to the elaborate “jack-pack” we found at the rear of the Sony monitor. The Sony has different connectors, among them a 34-pin connector for RGB (red, green, blue) and control signals from a computer. No such provision is available on the Teknika monitor.

On the basis of the video circuitry in Teknika’s schematic we would predict its performance to be that of a typical, good-quality color TV receiver; automatic frequency, and phase and color-correction circuits are of the standard type. The Sony monitor, on the other hand, contained a number of special circuits, including flesh-tone correction, which assure particularly life-like color reproduction. The Teknika monitor contains an on-off for color and phase correction, but its only function is to activate the present potentiometers via a screwdriver access or, in the manual mode, to permit the user to make corrections with the knobs on the control panel. Although called “automatic”, this switch does not control automatic circuitry.

From a technical point of view, the most significant performance difference between the Teknika ATV-M19 and its Sony counterpart is the video bandwidth of “not less than 3.0 MHz at 50% of amplitude.” The Sony monitor’s bandwidth is specified at 4.0 MHz. This difference in bandwidth may not be apparent on a weak, somewhat ghosty, TV broadcast picture. But it can certainly be seen when a high-quality video signal is available. The crisp, clear appearance of letter and numerals on the Sony monitor presents a sharp contrast to the merely good resolution we saw on the Teknika. Both monitors have a sharpness control, and in both cases it has a very limited effect.

**Laboratory Measurements.** As indicated in the accompanying table, the Teknika’s bandwidth ranged to 3.1 MHz. Dc restoration was an excellent 95% (producing bright, pure colors) and was obviously due to the restoration transistor circuit and the individual clamping levels at each subsequent video stage. Horizontal linearity and vertical linearity were quite good but not, as in the Sony unit, essentially perfect.

We determine horizontal and vertical linearity by displaying a grid pattern and actually measuring the difference, in centimeters, between the left and right portions of the screen, and the top and bottom portions, respectively. If the distance between grid lines at all points are of exactly equal length, the linearity is 100%. A 90% difference, as indicated in the table, means that the difference between the center, or reference line, and the other lines is 10%. The linearity measurements obtained for the Teknika 19-inch monitor are typical of those found in good quality 19-inch color TV receivers.

Similarly, convergence is measured by millimeters of overlap at individual grid lines at the screens top, center, bottom, and sides. Again the Teknika unit matched most color TV receivers, but fell short of in the Profeel.

The table also illustrates performance of the various voltage regulators—a good indicator of the entire system’s stability. Some of the regulation measurements are not as good as those of the Sony, but they are all adequate and will not affect picture quality.

We looked at color pictures provided by a studio camera, off-the-air color broadcasts, and via a high-quality VCR. The colors were, in general, very good but we noticed some imperfections in naturally occurring red and greens, e.g., trees and sunsets. When pure reds and greens appeared in a picture, they were faithfully reproduced but seemed particularly bright. This was not the case with blue and in-

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video bandwidth to CRT (-6 dB):</td>
<td>3.1 MHz</td>
</tr>
<tr>
<td>Dc restoration</td>
<td>95%</td>
</tr>
<tr>
<td>Horizontal linearity</td>
<td>95% left, 90% right</td>
</tr>
<tr>
<td>Vertical linearity</td>
<td>90% top, 90% bottom</td>
</tr>
<tr>
<td>Convergence</td>
<td>90% horiz., 85% vert.</td>
</tr>
<tr>
<td>Dc voltage regulation (115 V dc)</td>
<td>92%</td>
</tr>
<tr>
<td>(105 to 130 V ac)</td>
<td></td>
</tr>
<tr>
<td>High-voltage regulation</td>
<td>90%</td>
</tr>
<tr>
<td>(105 to 130 V ac)</td>
<td></td>
</tr>
<tr>
<td>12-volt dc regulation (Max. brightness variation)</td>
<td>90%</td>
</tr>
</tbody>
</table>
termediate colors. A concensus of five individuals provided a general satisfaction with the quality of Teknika’s color reproduction. Three of the five had also seen the same test on the Sony video monitor, and they felt Sony’s colors were more natural.

Conclusion. the Teknika ATV-M19 color video certainly provides good color pictures, probably better than the majority of commercial color TV receivers. As part of an integrated TV/FM/stereo component system, this monitor has the simplicity of interconnection and a high-quality picture to recommend it. While its suggested selling price of $599 is considerably higher than that of an ordinary 19” color TV model, the overall appeal of a modular component system is obviously attractive to a certain segment of the buying public. The manufacturer’s suggested price for a complete system—the 19” monitor, TV/FM stereo tuner with speakers, and an IR remote control—is $1200. The comparable Sony system is $1530, without the FM receiving capability. There may also be a variation in the quality of the speakers and stereo, but we cannot comment on this since no audio tests were performed.

For the consumer who is interested primarily in the quality of the TV picture, the additional cost of the Sony system may not be an objection. This is especially true if the monitor is to be used with a personal computer. Moreover, the Sony has a built-in stereo amplifier, allowing one to use it with a video cassette recorder as the TV tuner without adding an audio amplifier. And it has a “name”. For the average TV viewer who buys the optional tuner, there’s the gain of FM stereo, while providing good video performance at a lower price. If you are buying the video monitor alone, though and planning to use it with a VCR, the Sony and some others not mentioned would seem to be better choices. This view might change if Teknika’s next model corrects some of its shortcomings without raising the price appreciably.

—Walter Buchsbaum

CIRCLE NO. 103 ON FREE INFORMATION CARD

November 1982
The new QX-10 computer promises much for the future

At the National Computer Conference in Houston last June, I was shown a working prototype of a new computer that went under the code name of "Rising Star." The system was scheduled to be on its way to dealers by now so here are some of the details concerning it. Some of them are particularly noteworthy.

The computer is now called the QX-10 and it is manufactured by Epson. It consists of three major elements: the main system in an enclosure 20"W \times 13\frac{1}{2}"D \times 4"H, a keyboard unit approximately 20"W \times 9"D \times 2"H, and a video monitor 12\frac{1}{2}"H \times 13\frac{1}{2}"D \times 11"H. The main system contains the mother board, a sub-board, a power supply, a pair of integral low-profile 5\frac{1}{4}" Epson floppy disk drives, and five 60-pin expansion slot accessible through a lift-off door.

The keyboard uses an 8049 CPU and connects to the main board via a cable similar to a telephone cord for bidirectional operation at 1200 baud. The ASCII keyboard (there are several versions for different approaches) has 103 keys of which 58 are conventional, 19 are for numerics, 8 for cursor control, and 18 for special functions. The keyboard is provided with a choice of English, German, Italian, Danish, French, Spanish, or Swedish.

The video monitor has a 12" green-phosphor, black-face, nonglare CRT with a display format of 80 characters on 25 lines. Using an NEC \mu PD 7220, the graphics are capable of 640 \times 400 pixels. There is a character grid of 16 \times 20 that can be employed for user-defined characters. The sync is nonstandard at 20.8 kHz horizontal and 49.5 vertical.

The CPU is a Z80 operating at 4 MHz, while the memory consists of 64K of RAM, with a total of 256K bytes maximum on the main board. There are also 2K bytes of battery-backed CMOS RAM and a choice of 2K, 4K, or 8K bytes of EPROM. Other features include a battery-backed CMOS real-time clock, a small loudspeaker, a Centronics-compatible printer interface, RS-232C port, and a light-pen interface. Seven channels of DMA are provided along with 15 levels of interrupt and six counter/timers.

The twin floppy disk drives can store 320K bytes using 48 tracks/inch, double-sided. Data-transfer rate is 250K bytes/s; track-to-track access time is 35 ms; motor rising time is 500 ms; and power consumption is 15 W/drive. A hard disk is in the offing.

Across the top of the keyboard are four groups of pushbuttons. Under SYSTEM CONTROLS are STOP, HELP, COPY DISK, and UNDO. There are five under FILE CONTROLS: STORE, RETRIEVE, PRINT, INDEX, and MAIL. The four under APPLICATIONS are MENU, CALC, SCHED, and DRAW. Under TYPE STYLES are BOLD, ITALIC, SIZE, and STYLE. Almost all of these are self-explanatory, the last group being used for the printer. For the typist, the left side of the keyboard contains the MAR (margin) REL (release), TAB SET, and TAB REL (release) pushbuttons, all similar to those on a conventional typewriter.

Since we were only allowed to operate the machine for a half hour or so, we were not able to tell too much about its operation. However, in this brief time, I found it to be exceedingly user-friendly—far more so than most other machines we have ever used. This was due mostly to the superb operating software resident in the machine.

When turned on, it came up as a word processor. However, at any time, you could exit the word processor for another function and, after completion of that operation, the machine would pop right back to where you left off in the word processor. You can also jump from utility to utility, including using the modem, and the machine never faulted.

IBM Winchester. This add-on hard disk can be installed directly in the floppy disk area of the IBM
Personal Computer. It comes with 6, 12, or 18 megabytes/drive and the system controller can support up to four drives. The 6-megabyte version with controller, drive, and documentation is $2995; the 12-megabyte version is $3495; and the 18-megabyte is $4195. The disk controller, available separately, is $1950. Address: Datamac Computer Systems, 680 Almanor Ave., Sunnyvale, CA 94086 (Tel: 408-735-0323).

**TRS-80 Cassette Loader.** The LemonAid Loader fits between the cassette earphone jack and the TRS-80 and shapes the cassette output signal while removing noise, overshoot, and eliminating cassette loading problems. There are no volume control settings, no rewiring, adjustments, or software. The circuit is signal powered. $12.99. Address: Lemons Tech Services, 325 N. Highway 65, PO Drawer 429, Buffalo, MO 65622-0429 (Tel: 417-345-7643).

**Microcomputer Trainer.** The Micro-Professor is a Z80-based system featuring a six digit LED display, 2K-bytes of ROM (expandable to 8K), 2K-bytes of RAM, 24 I/O lines, 2K monitor, cassette interface, counter/timer circuits, a user wire-wrap area, 36-key keyboard, 9-volt power adapter, and an extension connector. The system is expandable. $129.95. Address: Etronix, 14803 N.E. 40th, Redmond, WA 98052 (Tel: 1-800-426-1044).

**CBM 16-Bitter.** The BX256 is a multiprocessor system using a 6509 and 8088 with an optional Z80, 256K of internal RAM expandable to 640K externally, 40K of ROM, and interfaces for IEEE-488, RS232, CBM cassette, 8-bit user port, and a cartridge slot. The green phosphor video monitor has 80 columns of 25 lines and has tilt/swivel controls. The detachable 94-key keyboard includes a separate numeric keypad featuring a double-zero key, clear entry key, and a double-size enter key for ease of use. The keyboard also has 10 user-definable keys. A built-in 6581 CPU allows a full 3-voice, 9-octave music synthesizer having an output for an external audio system. A dual disk drive is built in as is a real-time clock. Software includes BASIC 4.0, with options of CP/M, CP/M-86, and UCSD Pascal. The BX256 micro processor system supports all CBM peripherals. Planned price is $2995. Address: Commodore Business Machines Inc., The Meadows, 487 Devon Park Drive, Wayne, PA 19087 (Tel: 215-687-9750).
STAN VEIT ON COMPUTER SOFTWARE

VALDOCS
and the Mind Amp

Welcome to your new software column. Here's where I will keep you up-to-date on the world of operating systems, languages, applications, games, and graphics software. For starters, I consider the most important software development of the year to date to be VALDOCS, the operating software for an upcoming computer, the Epson QX-10 Mind Amp Computer.

The QX-10 is the result of a collaboration between U.S. software designers and Japanese engineers. It comes from the same source as the Epson printer and the Seiko watch. The American designers are with Rising Star Industries, a group that includes Chris Rutkowski and Roger Amidon, computer pioneers from the former Technical Design Labs (TDL) of Princeton, NJ. Rutkowski has been researching the interface between humans and computers for six years. The VALDOCS system and the QX-10 computer designs represent his efforts to implement the results of his studies. Before I go into a description of what VALDOCS and the QX-10 can do, let me give you a synopsis of the ideas that Chris has incorporated in his paper "An Introduction to the Human Applications Standard Computer Interface (HASIC)."

First he describes the computer environment of the years before 1975, when microcomputers were just beginning. Then he discusses the formative years from 1975 to 1981, when personal computers were in an embryonic state, just developing from an engineer’s tool into a small business and scientific utility. He describes each of the development stages of the computer and compares them to the development cycle of the automobile before and after 1925. He states that, after 1925, the automobile had achieved architectural stabilization (a state where the design of the major components had become stable).

In computers, he explains that architectural stabilization will occur when both the human and the computer do what they are best fitted to do without getting in each other’s way. The computer is best at manipulating symbols such as mathematical operators and functions, while the human is best at pattern recognition (the broad view of things). When the design is stable, the equipment is reliable, and it can be mass-produced to sell at a reasonable price, then the requirements for a “consumer” computer will have been met.

The hardware is fast approaching that point, but there has not been a comparable improvement in the software. Rutkowski describes the specifications for both a computer and a software operating system that will best interface with a human operator. It turns out that these are the specifications that went into the design of the QX-10 Mind Amp Computer. Since it is my purpose to talk about software in this column, I will stick as close to the subject as possible, though some hardware notes are difficult to ignore entirely.

The QX-10 VALDOCS Computer System consists of a Z80-based CPU with 128K of RAM, a video display, two built-in disk drives with 320 bytes per drive, full parallel and serial I/O, and of course an Epson printer. This is not an unusual group of components, but, when the VALDOCS operating system is added, there is a synergistic result (the whole is greater than the sum of its parts).

When you power up the QX-10 computer, VALDOCS is there ready to work for you. It comes up running the word processor. Thus, there is no requirement for the user to first access the system via the operating system. The word processor is very simple to learn. It is self-prompting and tutorial with HELP messages available when needed.

The detached keyboard design complements the software. There are seven main groups of keys on the keyboard. The first three are similar to almost all computer keyboards:
1. Alphanumeric typing keys
2. Editing/cursor movement keys
3. Numeric keypad

The last four groups are concerned with the essential system functions:
4. System controls
5. File controls
6. Applications
7. Type styles

The titles of these four groups are labeled on the keyboard.

Once learned, the word processor is very easy to use, operating on a “what you see is what you get” principle. It has both an editor and a formatter. If you decide you want to use boldface type or italics, just press the BOLD OR ITALIC key and the text on the screen appears in the type face you selected! Not only that, when you give the print command, the printer will print exactly what you see on the screen.

Of course you can also use the capability of the printer to produce condensed or expanded type. Whatever selection you make remains in force until you again hit the key to toggle it back to standard type. There are four type style keys: BOLD, ITALIC, SIZE, and STYLE. If you make a mistake or change your mind, you can use the UNDO key to return to the style you were using before you started changing things.

During your word-processing session, someone may ask you for a telephone number. You can put yourself on “hold,” by hitting the STORE key, then the RETRIEVE key, and proceed to ask the system for the address book. The information
for the person being sought appears on a subdivision of the screen. You find the phone number and mark it down or direct the system to send electronic mail. Press another key and you are back doing word processing again, just where you left off.

If you don’t know where to look for something, there is an index key that selects an index of all the files on the system. When you press it, you can selet one of three choices. You can view the index: (1) sequentially by date and time of creation, (2) alphabetically by index reference, or (3) alphabetically cross-indexed, with each word crossing to each other word.

The video screen layout is essentially the same for all menus: the display is subdivided into “windows,” each of which contains specific kinds of information. There is a document window that holds the full document you are working on. There’s also a smaller “interaction window” that appears when the system requires some specific information like “What is your name?” This always appears below the document window and can be 8 lines deep. Menus always appear in the interaction window. The third type of window is the prompt window, containing brief prompts or flags to get the user’s attention.

In addition to the word processor, the VALDOCS system contains a data base, an electronic mail system and communication program, an address book, a calculator, an appointment book, a note pad, a “things to do” file, a graphics package, and TP/M (a CP/M-type operating system that runs all CP/M applications software).

All these things are completely accessible to the user by means of simple key strokes.

Furthermore, I was told that a VALDOCS FPL (Forms Processing Language) is in the works to add electronic spreadsheet capability, forms generation, and report writing. With this, one will be able to write complex business applications without reference to any other language or system.

At this point, you might think that this must be an expensive system. It isn’t, since Epson is talking about a desktop computer that includes VALDOCS for about $3000. You may also think that I am describing something that will happen in the future. But according to Epson, units should be en route to dealers by the time you read this. Licensing of VALDOCS must undoubtedly be on Epson’s mind too.

**Format II.** For all those who own Apple II computers and long for a really good word processor without the expense of buying a Z80 board and WordStar, there is now a way to do it and also get a bonus in the form of a built-in mailing list system!

Kensington Software (300 E. 57th St., New York, NY 10022) has imported the Format II system from Great Britain, made some improvements, translated the already good manual into American English, and is selling the system disk for $275. You do need an 80-column board to use the system, but Kensington will provide the keyboard modification for upper/lower case and for redefining the zero-to-nine keys to word-processing functions. There is a version of the system that will work with all the popular 80-column boards for the Apple. I find this system to be as powerful as WordStar, but much easier to use. The mailing list section of the Kensington system is very useful and it will hold enough data about each entry to be considered a mini-data base.

**File Converter.** LoadCalc is a disk based program that converts any text file to a Visicalc (DIF) file. Data can now be received from Dow Jones or Compuserve and converted into VisiCalc format without retyping. Fractions are interpreted and converted to decimals. Data can be edited for conversion by row and column. Each field is analyzed and saved either as a Label or a Value in a DIF file. Program can be used with Visi-Trend/Plot and other Visi series software. $95. **Address:** Cypher, 121 Second St., San Francisco, CA 94105. (Tel: 415.974-5297).

**Word Processor.** The Electric Pencil has been configured for the NEC PC-8001 computer. It is the oldest and most popular word processor for microcomputers. It features full screen editing and a simple format menu that makes this system easy to learn and easy to use. The NEC disk version will sell for $99.95 and will be available from NEC dealers.

**Invaders for Osborne 1.** A disk version of the popular Invaders game has been released for the Osborne 1 Computer. Features a variable parameter file that can be changed by the user to increase the challenge of the game. $19.95. **Address:** Toolworks, 14478 Sherman Oaks, CA 91423. (Tel: 213-986-4885).

**Atari Adventure.** Probe One, a space adventure game for the Atari 400/800 features a hi-res color graphics disk with sound effects and arcade action. Requires BASIC cartridge and paddles or joystick. $34.95. **Address:** Synergistic Software, 830 North Riverside Drive, Suite 201, Renton, WA 98055. (Tel: 206-226-3216).

**IBM Reference Card.** This 14-panel reference for the IBM Personal Computer covers the BASIC with all options, commands associated with controlling BASIC for development and program execution, functions related to mathematics/ string manipulation and I/O, an alphabetized description of over 80 BASIC statements including disk and advanced versions, and color programming, etc. $2.50. **Address:** Minimagic Co., 104 Park Rd #34, West Hartford, CT 06119 (Tel: 203-233-6261).

**Screen Editor.** Designed for the IBM Personal Computer, this editor features full cursor movement, overlay or insertion modes, tab control, replacement of strings, adjust and margin control, searches in both directions, partition of buffer by set marks, file merging, and repeat count for most commands. $75. **Address:** Don-El Enterprises, 3261 Michigan Ave., Costa Mesa, CA 92626 (Tel: 714-546-7481).

November 1982
Playing a record in the same straight-line path taken by the recording lathe while it was cutting the master has been acclaimed by serious audiophiles for about two decades. Until recently, however, the few linear-tracking models available were not big sellers. Now a combination of factors has thrust them into the "popular" area in the eyes and minds of hi-fi stereo enthusiasts. The impetus has come from technological improvements and the near-total acceptance of single-play turntables, of course. Most important have been the introduction of a broad line of such turntables by a leading manufacturer, Technics; that company's development of plug-in connector ("P-type") phono cartridges; and the agreement of many cartridge makers to package their products to physical (not internal) standards set by Technics (not known as a major cartridge manufacturer).

The foregoing developments permit a user to buy one of a host of P cartridges on the market, plug in the cartridge, and tighten a single screw. There are no wires to attach and no settings to make. Everything is automatically adjusted. Moreover, by not requiring the extra height to lift a pivoted tonearm, a linear-tracking turntable can be made with a sleeker appearance. The lowest priced linear-tracking turntable in Technics' line, the Model SL-5, at a suggested retail price of $200 (typically heavily discounted), is the one we chose to examine here. We also tested P-type Technics and Shure cartridges in both the linear-tracking turntable and a conventional pivoted-arm turntable that accommodates P cartridges.

The Linear-Tracking Turntable. The Model SL-5 has a two-speed direct-drive motor. Speed and arm indexing are automatically selected by the record size, although provision is also made for manual speed selection. The cover (whose width and length are the same as a 12" record jacket) contains the servomechanism and a short radial arm, designed to accept only a special plug-in cartridge. The arm is balanced to give a vertical tracking force of 1.25 grams with the cartridge installed. A screwdriver adjustment permits varying the force between 1.0 and 1.5 grams should this be desirable. Overall dimensions are 12 1/2"W × 3 1/2"D and weight is 9.7 lb.

A feeler arm emerging from the platter (through a slot in the rubber mat) senses the presence of a record on the turntable and prevents the arm from indexing or descending if no record is present. Also, a record-size sensor outside the turntable diameter moves in to check on the size of the record. If it encounters the edge of a 12" disc, the turntable speed is set to 33⅓ rpm and the arm indexes to a 12" (30-cm) diameter. If no disc is found, the player speed automatically switches to 45 rpm and the arm indexes to a 7" (17-cm) diameter. A retractable center-hole adapter for 45-rpm records is built into the platter.

Nonstandard record sizes, in general, must be played by manual indexing and (if necessary) speed selection. A partial exception is made for 10" (25-cm) records, for which a special sensing adapter is placed on the record edge sensor. Although this sets the speed to 33⅓ rpm, the arm must be cued manually.

All the operating controls of the Technics SL-5 are pushbuttons located on the front edge of the base (the speed selector, with settings for 33/AUTO/45, is a slide switch on the motorboard base). Power is switched by a square button at the left, and an illuminated red arrow beneath the plastic cover above the arm shows its position against a scale calibrated in millimeters.

After a record is placed on the turntable and the cover is lowered, a light touch on the large rectangular START button initiates the operating cycle. The platter rotates, and the arm moves to place the stylus over the lead-in groove and lowers smoothly to the record surface. Holding in the START button causes the arm to slew slowly inward. It stops when the button is released, remaining raised until the CUEING button is pressed. (This control can be used at any time, raising and lowering the pickup on alternate operations.) At the end of play the arm lifts and returns to its rest position above the outer groove of a 12"
Give something special.

Gifts that keep on giving pride and satisfaction for years to come.

CIRCLE NO. 21 ON FREE INFORMATION CARD
Creating a fine and lasting product with your own hands brings special rewards. So share that pleasure by giving a Heathkit product. We've been helping people build pride for 56 years.

Gifts of accomplishment.

Taking the wrappings from a Heathkit is the beginning of an adventure. And often the start of a life-long fascination.

Simple starter kits help beginners develop confidence fast. More advanced projects challenge experienced kitbuilders.


And no experience is necessary. Every kit is backed with a promise: "We won't let you fail."

Help is always as close as the phone or your Heathkit Electronics Center. But even novices rarely need it. Our step-by-step manuals make building kits easy and fun.

Spend only a little to give hours of fascinating experience.

For example, a handsome quartz regulated digital wall clock. It's accurate to within a minute a year. costs under $50. Or a programmable doorbell that welcomes guests with music. Both are inexpensive starter kits that can be built in one or two evenings.

Anyone would appreciate a Heathkit automatic phone dialer. It stores 16 frequently used numbers. And is easy to build, inexpensive to give.

The Three-in-One Auto Tuneup instrument can be
Something they won't forget.

completed in an evening. Keeps cars in fine tune, and is a money saving gift for both you and the person to whom you give it.

For people on the go, give the "Explorer" five-inch B-W TV with AM/FM digital clock radio alarm. Powered by AC, DC, or its own batteries, you can give it for under $150.

For the audiophile in your life, what better gift than a Heathkit Stereo Receiver. If there's a photo hobbyist on your list, consider the Programmable Darkroom Timer. And for casual weather watchers and serious observers alike, a Digital Barograph is a unique gift.

For Hams, there is a wide selection of such Inexpensive but appreciated gifts as the Heathkit Micro-Matic Memory Keyer. And anyone interested in electronics can use a hand-held Digital Multimeter.

Give a priceless learning experience — an educational course in electronics or computer science. And any computer enthusiast would appreciate a computer kit, or one of a broad selection of peripherals and software.

Fine craftsmanship in wood is available in a variety of classic furniture pieces to build. Complete one and put something of yourself in a special gift. Or give a kit to build.

It's easy to give Heathkit gifts. Just turn the page.

Heathkit
Heath Company
It's easy to give Heathkit gifts.

Call 800-253-0570 toll free. (In Alaska, Hawaii and Michigan call 616-982-3411.) We'll tell you the location of your nearest Heathkit Electronics Center. Or take your order for any Heathkit product. You can charge it to VISA or MasterCard.

Heathkit gifts. Great to receive. Fun to build. Appreciated for years to come. Choose from the wide selection at your Heathkit Electronics Center. Or send for your free catalog today.

Free Catalogs!

Heathkit® Heath Company
Benton Harbor, MI 49022

"Yes, please send my FREE Heathkit Catalog(s)."

☐ Electronics (010-954)
☐ Furniture (476-954)
☐ Educational Products (584-954)

Name
Address
City  State  Zip

CO-1021

Heathkit Electronics Centers are units of Veritechnology Electronics Corp.
Prices subject to change. Simulated TV picture and CRT display.
record, shutting off the motor. Pressing the STOP button stops the platter and returns the arm to rest. Holding the STOP button in for more than a second causes the arm to slew toward the outside of the record so that the pickup can be cued to any point by alternate pressures on the START and STOP buttons. If the cover is raised while a record is being played, the turntable stops and the arm returns to its rest position. If power is interrupted during play, the arm lifts and remains in place until power is restored, at which time the arm returns to its rest and the unit shuts off.

These protective features make the Technics SL-5 virtually foolproof, with the exception of trying to play a 10" disc without using the special sensing adapter. It appears to be impossible to damage either the record, the cartridge, or the player mechanism without making a deliberate attempt to do so.

**Cartridges.** Although its original limitation to a single type of specially designed cartridge appeared to promise that acceptance of this novel system would be restricted, it soon became so popular that compatible cartridges were announced by a number of other manufacturers, and a de facto standard has come into being for P-type cartridges. Their key requirements include physical compatibility with the Technics tonearm, correct stylus position and angle for the Technics arm geometry, an overall weight of precisely 6 grams (to give a net downward force of 1.25 grams), and the ability to track properly at that force. They also are compatible with the 150-pF wiring capacitance of the Technics arm and cable. At present, such cartridges are available from most of the better-known manufacturers, including Audio-Technica, Empire, Ortofon, Shure, and Stanton, as well as Technics. The popularity of these cartridges and the reduction of total effective arm mass that they make possible has led Technics to produce a line of conventional record players whose pivoted tone arms are designed to accept the plug-in P-type cartridges. In addition, Technics and Shure (and no doubt most of the other cartridge manufacturers) can provide mounting adapters so that their P-type cartridges can be plugged into standard arms equipped with the EIAJ 4-pin headshell socket.

**Test Program.** One of the finest P-type cartridges offered by Technics is its P205CMK3 ($210). It is a moving-magnet cartridge with a samarium cobalt magnet and a boron pipe cantilever claimed to give it an effective tip mass of less than 0.15 mg. Its 0.2 x 0.7 mil elliptical diamond stylus is in a user-replaceable assembly.

In addition to testing the Technics SL-5 turntable and its P205CMK3 cartridge, individually and as a record playing system, we wished to judge the degree of overall flexibility of the P-type system, which seems destined to become a permanent part of the hi-fi record playing scene. To this end, we also used a Shure V15 LT cartridge ($190), a P-type equivalent to its V15 Type IV, to which it is mechanically and electrically identical. Like all P-type cartridges, it is designed to resonate at about 12 Hz in the Technics linear tracking arm. It is near the top of its manufacturer's line.

For comparison, we also tested a Technics SL-D30 record player ($170), a conventionally styled single-play automatic unit with performance, price and features generally similar to those of the SL-5, but using a conventionally pivoted tonearm designed to accept only P-type cartridges. The SL-D30 measured 17°W X 4°H X 14 ¾°D and weighs 10.6 lb. Both of our test cartridges were used in both turntables.

**Test Procedures.** The cartridges were checked for frequency response and crosstalk in the arm of the SL-5 record player (using the CBS STR100 test record). The actual capacitance shunting the standard 47,000-ohm load resistance was measured, and the effect of reasonable variations in capacitance on frequency response was determined. The vertical stylus angle of each cartridge was evaluated as were the output voltage and channel unbalance.

The tracking ability of each cartridge was judged by playing high-speed test records, including the German Hi-Fi #2, Fairchild 101, Cook 60, and Shure Audio Obstacle Course ERA IV and ERA V. The low-frequency resonance between the stylus compliance and total effective arm/cartridge mass was measured (approximately) with the aid of the Shure records. These procedures were then repeated with each cartridge plugged into the arm of the SL-D30 record player.

The record players themselves were evaluated for rumble, flutter, speed error and range of control (in the SL-D30), automatic cycling time, and susceptibility to base-conducted vibration. The accuracies of the tracking force and anti-skating calibrations of the SL-D30 arm were checked. (The vertical force of the SL-5 arm cannot be measured, and it has no need of anti-skating correction.)

**Test Results.** The two record players, which appear to be very similar in their specifications, measured nearly identically and were unaffected by the choice of cartridge. The unweighted rumble of the SL-5 was -40 dB, and with ARLL weighting it was -62 dB, both excellent figures. The SL-D30 rumble readings were nearly as good: -38 and -60 dB. The two units had nearly identical flutter readings, although their frequency spectra were slightly different. The SL-5 had a DIN weighted peak flutter of ±0.07%, and the SL-D30 reading was ±0.08%. (The difference between the two was well within the normal range of measurement uncertainty.) In the SL-5, however, the flutter was concentrated between 5 and 10 Hz, while in the SL-D30 it was randomly distributed up to about 20 Hz.

Operating speeds of the two turntables were correct. (In the SL-D30 they could be varied over a range of +7.0% to -8.5%.) Tracking force of the SL-D30, when set for 1.25
grams, was 1.35 grams, and its antiskating calibration was reasonably accurate (although we preferred to set it to 1.5 grams for best correction at the “1.25 gram” force). There was no lateral arm shift during a cueing lift and descent cycle with either turntable.

It was not possible to judge the tracking error variations in the servo-driven arm of the SL-5, although it was evident that the arm had a small amount of free movement to accommodate record eccentricity. In the case of the SL-D30, the tracking error was very low—less than 0.4 degrees per inch over the surface of a 12-in. record. The SL-D30 arm had an effective mass of 14 grams including the cartridge (8 grams net, which is a relatively low figure for a conventional pivoted arm). The rated mass of the SL-5 arm plus cartridge is 9 grams; we could not measure it because of the design of the unit. These data indicate that the resonance frequency of a given cartridge in the SL-D30 should be about 20% lower than in the SL-5 and this was confirmed by our measurements. The SL-5 resonance was at 10 to 12 Hz, with a clearly visible vertical arm vibration when using the Shure test records. The SL-D30 resonated at 8 Hz, though with a considerably lower amplitude.

The auto start and stop cycle operations of the SL-D30 required about 12 seconds each. It can be operated manually, however, by simply lifting the arm from its rest (which starts the motor) and cueing it. The SL-5 requires only 6 seconds to reach the lead-in groove after start is pressed, and it takes about 10 seconds from the time it lifts out of the eccentric groove at the end of the record to the shut-down of the player. Its arm cannot be moved manually, except by holding the slewing buttons in to servo-drive the arm. This movement is at a rate of about 0.6 cm per second.

In their responses to base-conducted vibration in the audio range (20 to 1000 Hz) both turntables were typical of the recent models we have tested; except for the range between 30 and 60 Hz they were much alike. However, between 30 and 60 Hz the SL-D30 was some 10 to 20 dB better than the SL-5 in its rejection of transmission from the mounting feet to the stylus.

Both cartridges proved to be outstanding performers. The Technics P205CMK3 had a slightly flatter overall response, within ±0.5 dB up to 12,000 Hz and rising to +2.5 dB at 20,000 Hz. A load capacitance increase from 200 to 335 picofarads boosted the output only slightly, by about 1 dB above 8000 Hz. Its channel separation was 20 to 25 dB up to 10,000 Hz, and 10 dB at 20,000 Hz. The output at 3.54 cm/s was a fairly low 2.4 millivolts, and the channels were matched within 0.5 dB.

The Shure cartridge had a somewhat similar frequency response, extremely flat (within 0.5 dB overall) up to 14,000 Hz, but rising more abruptly to +5 dB at 20,000 Hz. The change in load capacitance also had a very small effect on the frequency response. The channel separation was 25 to 30 dB up to 10,000 Hz, and about 10 dB at 20,000 Hz. Its output was a relatively high 4.1 millivolts, with the channels balanced within 0.85 dB.

The tracking ability of the Shure cartridge was excellent, including its perfect tracking of the 100-micrometer level of the German Hi-Fi record (a feat matched by very few cartridges). Except for a trace of mistracking on the highest level of the flute (ERA IV) and the highest level of the trackability test of the new ERA V Shure record, it easily coped with every signal we applied to it.

The Technics cartridge tracked everything on the ERA IV record without trouble, but mistracked on the two highest levels of the ERA V record. It was also able to track only as high as the 70-micrometer level of the German Hi-Fi record.

**User Comments.** The measured differences between the two record players were essentially what could have been predicted from their specifications, and there were no audible differences. The two cartridges were also so closely matched in performance we could detect no audible differences between them on a variety of records played, other than the very apparent level difference. As with most good cartridges, the sound was effortless and uncolored, since the high-frequency emphasis in each case was well above the normal frequency range of recorded music.

This does not in any way imply that these two record players are equally suitable for every user. The linear tracking SL-5 is, in most respects, a uniquely simple and functional instrument whose features are unavailable in any other unit we know of selling for anywhere close to its price.

In respect to freedom from rumble, hum, or mechanical noise, the SL-5 would be hard to match. Perhaps the integrated design of the cartridge and its plug, which eliminates all the shielded wires that normally connect a shell-mounted cartridge to its plug, combined with the muting system that shorts the audio outputs when the pickup is not on the record, is responsible for this. Whatever the case, we were struck by the total silence, even at a very high playback volume, when using this record player. The same comment applies to the SL-D30, and probably for the same reasons.

The choice between these two units—and, obviously, between any conventional player and a fully automatic type—must be made on the basis of one’s listening habits and desire for involvement with the hardware of a hi-fi system. The SL-5 is ideally suited for playing a record from beginning to end, or at least, for starting at the outside of the disc. Although the arm can be slewed with adequate ease and precision, it is difficult to see the (unlit) record grooves through the cover.

On the other hand, the open construction and manual cueing capability of the SL-D30 (or any other conventional player) is a great convenience if one wishes to listen to a selection within a record. Balancing this is the total protection offered to one’s records and cartridge by the SL-5, to say nothing of the ease with which it can be used by anyone, even a young child, without the risk of damaging a valuable record or pickup.
We don't care which computer you buy.
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 multi-channel 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, 800-848-8990, for an illustrated guide to the CompuServe Information Service. The videotex service for you, no matter which computer you buy.

CompuServe
P.O. Box 20212
5000 Arlington Centre Blvd. Columbus, OH 43220
800-848-8990
In Ohio call 614-457-8650
An H&R Block Company
Learning electronics is no picnic.

At any level it takes work and a few sacrifices. But with CIE, it's worth it.
Whoever said, "The best things in life are free," was writing a song, not living a life. Life is not just a bowl of cherries, and we all know it.

You fight for what you get. You get what you fight for. If you want a thorough, practical, working knowledge of electronics, come to CIE.

You can learn electronics at home by spending just 12 hard-working hours a week, two hours a day. Or, would you rather go bowling? Your success is up to you.

At CIE, you earn your diploma. It is not handed to you simply for putting in hours. But the hours you do put in will be on your schedule, not ours. You don't have to go to a classroom. The classroom comes to you.

**Why electronics training?**

Today the world depends on technology. And the "brain" of technology is electronics. Every year, companies in the world over are finding new ways to apply the wonders of electronics to control and program manufacturing, processing...even sophisticated equipment.

And the more electronics applications there are, the greater the need will be for trained technicians to keep sophisticated equipment finely tuned and operating efficiently. That means career opportunities in the eighties and beyond.

**Which CIE training fits you?**

Beginner? Intermediate? Advanced? CIE home study courses are designed for ambitious people at all entry levels. People who may have:

1. No previous electronics knowledge, but do have an interest in it;
2. Some basic knowledge or experience in electronics;
3. In-depth working experience or prior training in electronics.

You can start where you fit and fit where you start, then go on from there to your Diploma, FCC License and career.

**Many people can be taught electronics.**

There is no mystery to learning electronics. At CIE you simply start with what you know and build on it to develop the knowledge and techniques that make you a specialist. Thousands of CIE graduates have learned to master the simple principles of electronics and operate or maintain even the most sophisticated electronics equipment.

**CIE specializes exclusively in electronics.**

Why CIE? CIE is the largest independent home study school that specializes exclusively in electronics. Nothing else. CIE has the electronics course that's right for you.

Learning electronics is a lot more than memorizing a laundry list of facts about circuits and transistors. Electronics is interesting! It is based on recent developments in the industry. It's built on ideas. So, look for a program that starts with ideas and builds on them. Look to CIE.

**Programmed learning.**

That's exactly what happens with CIE's Auto-Programmed Lessons. Each lesson uses famous "programmed learning" methods to teach you important principles. You explore them, master them completely, before you start to apply them. You thoroughly understand each step before you go on to the next. You learn at your own pace.

And, beyond theory, some courses come fully equipped with electronics gear (the things you see in technical magazines) to actually let you perform hundreds of checking, testing, and analyzing projects.

**Experienced specialists work closely with you.**

Even though you study at home, you are not alone! Each time you return a completed lesson, you can be sure it will be reviewed, graded and returned with appropriate instructional help. When you need additional individual help, you get it fast and in writing from the faculty technical specialist best qualified to answer your question in terms you can understand.

**CIE prepares you for your FCC License.**

For some jobs in electronics, you must have a Federal Communications Commission (FCC) License. For others, some employers tend to consider your license a mark in your favor. Either way, your license is government-certified proof of your knowledge and skills. It sets you apart from the crowd.

More than half of CIE's courses prepare you to pass the government-administered exam. In continuing surveys, nearly 4 out of 5 graduates who take the exam get their licenses! You can be among the winners.

**Associate Degree**

Now, CIE offers an Associate in Applied Science Degree in Electronics Engineering Technology. In fact, all or most of every CIE Career Course is directly creditable towards the Associate Degree.

Today is the day. Send now.

Fill in and return the postage-free card attached. If some other ambitious person has removed it, 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 name and date of this magazine) at: 1776 East 17th Street, Cleveland, Ohio 44114.
As you know, one picture is worth a few thousand numbers.

As you may not know, Apple® Business Graphics software can generate more types of pictures, in more colors, using more data than any other graphics package.

So you not only get the usual bar graphs and pie charts. You also get unusual bar graphs and pie charts. Sophisticated line and area graphs. Even scattergrams. All teamed with extremely useful and powerful features—exploded views, unlimited overlays, floating titles and more.

<table>
<thead>
<tr>
<th>Graph Types</th>
<th>Apple</th>
<th>VisiTrend/VisiPlot</th>
<th>pfsGraph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Vertical Bar</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Horizontal Bar</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Side-by-side Bar</td>
<td>Up to 4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Pie</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Partial Pie</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Scattergram</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Curve Fitting</td>
<td>5 Kinds</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>Data Points (Max.)</td>
<td>3500+</td>
<td>645</td>
<td>36</td>
</tr>
<tr>
<td>Printer Compatible</td>
<td>Any</td>
<td>None</td>
<td>H-P7470A</td>
</tr>
<tr>
<td>File Types</td>
<td>Pascal</td>
<td>BASIC</td>
<td>pfs</td>
</tr>
<tr>
<td></td>
<td>VisiCalc</td>
<td>VisiCalc</td>
<td>VisiCalc</td>
</tr>
<tr>
<td>Math Functions</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Available Colors</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Apple Business Graphics is available for both the Apple II and Apple III.

Equally important, with our graphics package you’ll find more ways to see what you’re doing. On the monitor of your choice. And on virtually any printer or plotter on the market.
graphics are alike. pictures to prove it.

Even on transparencies and slides (by combining Apple Business Graphics with packages like Screen Director™ and Target Image Maker™).

All of which makes for more presentable presentations.
And more revealing market analyses, forecasts, budgets, stock trends, business plans or customer demographics.

Or the information of your choice from the files of your choice. Be it VisiCalc®, Pascal, DIF or BASIC.

We could easily tell you more.
But we'd rather show you more. In person. At any of our over 1300 full-support dealers (they also offer a vast library of other quality software distributed by Apple for Apples).

So pay one a visit. And find out how easy it is to turn a sea of data into data you can see.

The most personal software.

Call (800) 538-9696 for the location of the authorized Apple dealer nearest you, or for information regarding corporate purchases through our National Account Program. In California (800) 662-9258. Or write Apple Computer Inc., Advertising and Promotion Dept., 20515 Mariani Ave., Cupertino, CA 95014.

Screen Director is a trademark of Business Professional Software, Inc. Target Image Maker is a trademark of Comshare Target Software. VisiCalc® is a registered trademark of VisiCorp.
Apart from operating convenience and protection features, there is one salient advantage to both these units (especially the SL-5). Namely, the low mass of the arm/cartridge combination provides an outstanding ability to play warped records. The SL-D30, whose low arm mass is matched by only a few units we have tested, could play most of the warped records in our collection. The SL-5, as might be expected from its extremely low-mass arm, was at least the equal of any record player we have used. It tracked easily and with no tendency to leave the groove or even betray the presence of a warp by its sound on every record we used that has been tracked by any other pickup.

The only limitation we found on the warp-tracking ability of the SL-5 resulted from the very small clearance between the edge of the record and the covering of the arm servo. This sometimes caused a rubbing contact against a badly warped record.

What about the virtues of the P-type cartridges for use in conventional arms? The principal one, as we see it, is their low mass of 6 grams, contrasted with 15 to 25 grams for most conventional cartridge and headshell combinations. In an arm such as the one on the SL-D30, this provides a much improved warp-tracking ability—no trivial advantage. The reduction in hum and noise pickup due to a more complete shielding of the cartridge area is another plus. The only disadvantage we can see to the P-type cartridge is its incompatibility with standard arms without the mounting adapter. Use of the adapter, however, would negate most of the advantages we have discussed. Also, one’s choice of cartridge types is not too wide. For example, Shure’s top-of-line V15 Type V is not available as a P-type.

My experience with the Technics linear-tracking turntables and the P-type cartridges convinces me that they represent a worthwhile advance in phono reproduction equipment for many people. Their growing popularity is easily understood. —Julian D. Hirsch

CIRCLE NO. 102 ON FREE INFORMATION CARD

McIntosh Model MA6200
Integrated Stereo Amplifier

THE McIntosh MA6200 integrated amplifier, rated at 75 watts per channel into 8-ohm loads (or 100 watts into 4 ohms), features the company’s exclusive Power Guard circuit that makes it impossible to clip the output waveform. The amplifier can drive up to three pairs of speakers simultaneously, and has control facilities for two tape decks.

The MA6200 is styled like other McIntosh products, with a gold-plated black panel, pale gold and black knobs, and a black metal cover. The panel markings are softly back-lit in green. The amplifier is fitted with the company’s exclusive feature that simplifies making a neat, flush panel installation, yet permits instant withdrawal of the unit.

The front panel of the MA6200 is 16" wide and 57/16" high. The chassis is 13" deep, and the amplifier weighs 30 pounds. Suggested retail price is $1649.

General Description. The phono preamplifier of the MA6200 is a low-noise operational amplifier, whose open loop gain of 100,000 is reduced to 42 dB at 1000 Hz by the precision low-noise feedback components that provide the RIAA playback equalization. The low output impedance of the op amp permits it to drive the low-impedance feedback network (used in the interest of minimum noise) without distortion.

The following high-level section provides the loudness compensation, which is unlike the usual loudness control system in other amplifiers. Two op amp stages are used, providing a fixed 20-dB gain at middle frequencies, regardless of the setting of the loudness knob. Advancing the knob from its counterclockwise (OFF) position introduces a bass boost below about 300 Hz. Above 1000 Hz the output is boosted with a "shelved" characteristic, to a maximum of +2.5 dB. The loudness compensation is independent of the volume control. Instead of the usual bass and treble tone controls (or a third midrange control), McIntosh has chosen to use a 5-band equalizer in the MA6200. Controlled by conventional rotary knobs, it is not actually a "graphic equalizer," but is equivalent to one in its operation. Each channel uses an op amp at the input and output of the equalizer, plus five more to synthesize the filter characteristics. The center frequencies of the adjustments are 30, 150, 500, 1500, and 10,000 Hz, and each control has a nominal range of ±13 dB.

The power amplifier section is separated electrically from the preamplifier, to which it is joined by jumpers inserted into rear apron jacks. If the jumpers are removed, signal processing accessories such as dynamic expanders or noise reducers can be inserted into the signal path. The output stages are push-pull, de-coupled, complementary-symmetry amplifiers. They are protected by thermal sensors that disconnect the speakers if
3.7 million reasons why the ATARI Home Computer is something to see.
The display screen used with our computers is composed of 192 horizontal lines, each containing 320 dots. Delivering color and luminosity instructions to each dot for a second requires 3.7 million cycles...a lot of work for the normal 6502 processor.

That's why the ATARI computer has equipped its 6502 with its own electronic assistant. It's called ANTIC, and it handles all the display work, leaving the 6502 free to handle the rest. What this means to you is uncompromisingly spectacular display capabilities without loss of computer power needed to carry out the demands of your program.

That's a quality you just don't find in ordinary personal computers. And it's one of the reasons some computer experts say that ATARI computers are so far ahead of their time.

There's more...which is what you'd expect from ATARI.

Language. The ATARI Personal Computer uses several programming languages to give the user maximum control of its extraordinary capabilities. PILOT, Microsoft BASIC*, and ATARI BASIC are understood and spoken by the ATARI computer. You'll also find our Assembler Editor cartridge indispensable for machine language programming.

Sound. An ATARI computer has four sound generators, or voices, activated by a separate microchip. This leaves the principal microprocessor chips free to perform other tasks. And you can take full advantage of this capability which is designed for easy programming.

Change. ATARI Home Computers have been designed to make change and expansion easy. The ATARI computer has a modular operating system* that can be easily replaced as new technology develops. If you need it, memory expansion requires no more than inserting additional RAM modules*. And the ATARI ROM cartridge system also makes it easy to change languages. In short, your ATARI computer won't be obsoleted by future developments...because it already incorporates the future.

Sharing. To learn more about the amazing capabilities of ATARI computers, visit your local computer store for a demonstration. Or send for our Technical User's Notes, intended for the serious programmer. They are only $27 and contain a lot more information about our computers' special capabilities than most companies could tell.

See your ATARI dealer, or send $30 ($27 plus $3 postage and handling), payable to ATARI, to Technical User's Notes, c/o ATARI Customer Service, 1340 Bordeaux Avenue, Sunnyvale, CA 94086.

*ATARI 800* computer only.
A low-cost plug-in board turns an Apple II computer into a graphics giant with 240 color choices

By Ray Dahlby

Enhancing the utility of his/her computer is among the most fruitful accomplishments that a computerist can achieve. It separates the appliance operator from the innovative enthusiast. An Apple II microcomputer, for example, can produce the dramatic displays shown at right by simply plugging in an under-$100 hardware board (assembled in about an hour with the plans presented here) and running some software.

This accessory luminance board enables an Apple II to block-shade text with one of 16 brightness levels for 240 low-resolution colors in place of the normal 16 colors, and simultaneously display bar graphs with high resolution. In addition to luminance control, the circuit adds a video interrupt mechanism for synchronous video-screen page flipping and screen splits. This makes it possible to expand the Apple's mixed text and graphics mode so that text can be displayed above or below the graphics.

Using the board you can even display part of page 1 hires graphics with part of the graphics on page 2, or you
Try this with an ordinary computer.

Epson.

The new Epson HX-20 is no ordinary computer. Not by a long shot. It's the world's only Notebook Computer with the power of a desktop and the portability of a handheld.

So you can do serious computing, data processing, even word processing. Anytime. Anywhere.

To start with the HX-20 has 16K RAM (optionally expandable to 32K), 32K ROM (optionally expandable to 64K), RS-232C and serial interfaces, a full-size ASCII keyboard, a built-in microprinter with dot addressable graphics, a scrollable LCD screen, five programmable function keys, and... well, that's just the beginning.

The HX-20 is small enough to tuck inside a briefcase or under your arm. It runs on internal power for 50-plus hours and recharges in eight. It lets you interface with peripherals like MX Series printers, the CX-20 battery-powered acoustic coupler, a barcode reader, and audio cassette. And you can even get it with options like a micro-cassette drive, ROM cartridge, floppy disk and display controller.

Now, prepare to have your mind boggled by one more feature: the price. The Epson HX-20 Portable Notebook Computer retails for less than $800. That's right — less. Which means it's just right for students, businesspeople, kids — anybody who's looking for an affordable way into serious computing.

Powerful. Portable. Affordable. The HX-20 is just what you'd expect from Epson.

The extraordinary.

EPSON
EPSON AMERICA, INC.
COMPUTER PRODUCTS DIVISION

3415 Kashiwa Street • Torrance, California 90505 • (213) 539-9140
CIRCLE NO. 12 ON FREE INFORMATION CARD
can display them simultaneously for a double-resolution graphics display of 560 x 192 pixels. All of this is accomplished without complex modifications to existing Apple equipment and without losing the normal display modes. The card plugs into slot 7 as shown in the photo below.

The luminance component of a television signal contains brightness information about the image being viewed. Similarly, to add luminance capabilities to a computer, brightness information must be added to its video output. The circuit card supplies this information from a 2048 x 4-bit RAM memory. Data is mapped to overlay the Apple’s screen in a 40 x 48 array of pixels. Data written to each
memory location determines the brightness level of the corresponding pixel.

Since 16 tone levels rival the quality of photographic film, 4 bits was considered adequate. The spatial resolution of $40 \times 48$ or 1920 pixels was chosen for high-speed animation and memory-size reduction.

Each luminance pixel precisely overlays a $7 \times 4$ dot area of the screen, adding luminance attributes to one block of low-res or an equivalent area of hi-res. Two luminance pixels stacked vertically will shade one text character.

The circuit's interrupt mechanism is derived from its on-board scan generator and can be programmed to produce an interrupt request on any multiple of four scan lines. This feature allows smooth animation plus synchronous page flipping. The 60-Hz interrupts can also be used as a real-time clock. A block diagram is shown in Fig. 1, with the complete schematic shown in Figs. 2 through 5.

**Circuit Operation.** The central element of the board is 6845 CRT controller $IC1$ (Fig. 1). It is used to
The Freedom Phone® Cordless Telephone Model FF-3500 has more features than any ordinary telephone. But one ordinary feature is missing.

There's no cord to tie you down. The compact handset measures 1" x 5⅛" x 2¾" and weighs just 7 ounces. So it's really easy to take or make calls anywhere within its operational range. That's upstairs, downstairs, in the front yard, backyard, at the neighbors, up the street, or down the block.

Instead of going to the phone to talk, you take the phone with you.
The Freedom Phone 3500 is the first cordless telephone that's small enough to fit in your pocket.

Designed and built exclusively for the Electra Company, makers of Bearcat® Scanners, the Freedom Phone 3500 provides crisp and clear cordless calls. An audible tone and pulsing light confirm dialing. The touch of a button automatically redials the last number entered.
The Freedom Phone Cordless Telephone is as easy to install as it is to use. Its attractive and compact base station plugs into your existing phone line and electrical outlet.

If the idea of using a Freedom Phone Cordless Telephone has a nice ring to it, get up, walk to your obsolete telephone, and call 800-4-4-P-H-O-N-E. You'll learn more about the Model FF-3500 and get the name of the nearest Freedom Phone Dealer.

**THE FREEDOM PHONE® CORDLESS TELEPHONE.**
synchronously regenerate the video RAM addressing not available on the Apple bus. This IC is programmed for the Apple video timing, then phase locked to the sync pulse on pin 19 of slot 7.

The circuit then runs in step with the Apple video, providing addressing for the on-board 2K × 4 luminance RAMs IC5 and IC6, which store the brightness level of each luminance pixel. The RAMs can be read from, or written to, transparently by the Apple during phase 2 of the processor clock. This removes the "glitches" that are common to many 80-column plug-in boards. Address multiplexing is taken care of by IC2, IC3, and IC4 (Fig. 3).

During phase 1 of the processor clock, contents of the luminance RAM addressed by IC1 are fed to IC12 (Fig. 5) which in turn drives the four-bit D/A comprised of elements of IC13 and its associated resistor/ladder network. This converts the digital data into a 16-level analog signal. The output of this network, preset by R11, is coupled to the Apple baseband video output.

In IC17 (Fig. 4) and its associated circuit the vertical sync signal is extracted from the composite signal that appears on pin 19 of slot 7. The resulting output provides a reference for the phase locking. The remainder of the phase-lock circuit is formed from IC10, IC15A, IC16, and elements of IC19 in Fig. 4, and a portion of IC12 of Fig. 5.

**Construction.** The circuit can be built on any Apple prototyping board using wire wrap or, alternatively, on a pc board such as that shown in Fig. 6. Since some elements of the circuit operate at 7 MHz, take care when using the point-to-point wiring technique.

---

**TABLE I**

<table>
<thead>
<tr>
<th>Revision</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>On</td>
<td>Off</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>7 and up</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

Future: Off On On

*S3 enable interrupts and is independent of revision number.
The Apple II has undergone several revisions in video timing to accommodate new TV receivers. This circuit handles these timing changes via the four DIP switches on the board. After determining the

The use of sockets is recommended for the ICs, and caution must be observed with static-sensitive MOS devices IC1, IC5, IC6, and IC16.

After all components are installed (Fig. 7), carefully check all connections. A miniature DIP switch can be used for the four switches called for in the circuit. Attach a short length (6" to 8") of insulated lead to the luminance output (top of R11), and terminate the lead with a small alligator clip.

The Apple II has undergone several revisions in video timing to accommodate new TV receivers. This circuit handles these timing changes via the four DIP switches on the board. After determining the
Fig. 5. Luminance output is obtained from D/A IC13.

**TABLE II—INITIALIZATION (ASSEMBLY)**

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEL</td>
<td>$0900</td>
</tr>
<tr>
<td>LDX</td>
<td>#00</td>
</tr>
<tr>
<td>STA</td>
<td>TABLE, X</td>
</tr>
<tr>
<td>INX</td>
<td>#16</td>
</tr>
<tr>
<td>BNE</td>
<td>INIT</td>
</tr>
<tr>
<td>JSR</td>
<td>WAIT</td>
</tr>
<tr>
<td>BIT</td>
<td>LOCK</td>
</tr>
<tr>
<td>RTS</td>
<td></td>
</tr>
<tr>
<td>WAIT</td>
<td>LDX</td>
</tr>
<tr>
<td></td>
<td>#01</td>
</tr>
<tr>
<td>HERE</td>
<td>DEX</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BNE</td>
</tr>
<tr>
<td></td>
<td>HERE</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RTS</td>
</tr>
</tbody>
</table>

**HEX OBJECT CODE**

78, A2, 00, 8E, F0, C0, BD, 23, 03, 8D, F1, C0, E8, E0, 10, D0, F2, 20, 18, 03, ZC, F2, C0, 60, A2, 01, A0, FF, CA, D0, FD, 88, D0, FA, 60, 40, 28, 08, 3F, 06, 30, 35, 00, 03, 20, 00, 00, 00, 00

Revision number of your system, set the four DIP switches in accordance with Table I. The initialization software shown in Table II can be entered and assembled with any compatible editor/assembler. If desired, you can enter the hexadecimal code of the listing in the computer. Then run the initialization routine.

With the Apple II powered off, connect the luminance lead alligator clip to the center connector of the video output connector at the rear of the motherboard. Install the Syncard in slot 7.

If you are using a video modulator that gets its video from the four-pin connector in the Apple, it will have to be modified. In the case of an M&R Supr-Mod, cut the brown lead coming from the modulator and patch the video from the rear of the Apple to the auxiliary input of the Supr-Mod. Rotate the modulator level control full clockwise and re-install it. Even without the board, the modulator will work normally. Other r-f modulators should be similar.

With the initialization program of Listing 1 loaded in the computer, call 768. You should see a random pattern of gray-scale blocks overlaying the screen, aligned exactly with the normal video output. If the luminance display is not precisely positioned, the DIP switches must be reset. After experimenting with the DIP switches (note that SJ3 is always off), re-run the initialization routine.

When the board is running, adjust luminance control R11, and the video output level of the Apple for a good picture without tearing. There will be a loss of vertical sync until the Syncard is initialized. If desired, this can be avoided by temporarily...

**TABLE III PROGRAM PARAMETERS**

- **$C0F0**: 6845 register select
- **$C0F1**: 6845 data register
- **$C0F2**: Lock
- **$CFFF**: Disable access to luminance RAM
- **$C700**: Enable access to luminance RAM
- **$C800**: Luminance RAM
- **$C7F**: Luminance RAM

*See 6845 data sheet.*
temporarily disconnecting the alligator clip from the video connector (the board will not deliver an output when this is done).

**Programming.** With the luminance board running, a machine-language programmer can start experimenting immediately. Program parameters are shown in Table III. The gray-scale RAM is located in $C800$ to $CFFF$. By writing values between 0 and 15 into this area,
pixels can be set to the desired brightness level. The screen is linearly mapped with SC800 at the upper left corner. The high bit of each location in the luminance RAM indicates vertical synchronization status. This signal can be used to flip pages synchronously with the video frame rate.

If you don’t use machine language, a special operating system has been written for the Apple that forms a subset of Applesoft BASIC. Twenty special commands have been added, as shown in Table IV. This sub-interpreter is too lengthy to be listed here, so it is being made available on diskette from the source shown in the Parts List. The floppy diskette also contains demonstrations.

When the sub-interpreter is run, it installs itself just below DOS, and it resets Hi-Mem so that BASIC programs will not overwrite it. Three demonstration programs and pictures of the results accompany this article to show what can be done with the luminance board and the sub-interpreter.

The result of “polishing” your Apple with these low-cost additions will clearly expand the utility of your computer, providing you with astounding video results and a new challenge.

TABLE IV—SPECIAL COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&amp;LOCK</td>
<td>Synchronizes the timing of the board to the Apple. It executes an &amp;NOSHOW, so after locking, you must &amp;SHOW to see the luminance screen.</td>
</tr>
<tr>
<td>&amp;SHOW &amp;NOSHOW</td>
<td>Switches the luminance display on and off. Does not alter the content of the luminance RAM.</td>
</tr>
<tr>
<td>&amp;CLR,X</td>
<td>Clears the luminance screen to the shade indicated by the expression after the comma. (0-15)</td>
</tr>
<tr>
<td>&amp;SHADE,X</td>
<td>Sets the shade for the &amp;PLT and &amp;FILL commands.</td>
</tr>
<tr>
<td>&amp;PLT,X,Y</td>
<td>Plots a pixel of the shade specified by the last &amp;SHADE command. Same screen coordinates as lo-res</td>
</tr>
<tr>
<td>&amp;RTN,X,Y</td>
<td>Used to return the shade of the indicated X,Y location. Like the &quot;SCRN&quot; function of Applesoft except the value is returned through location 255 ($FF)</td>
</tr>
<tr>
<td>&amp;FILL,X,Y, X1,Y1</td>
<td>Fills a rectangular block with the shade specified by the previous shade command. Same restrictions on X and Y values as lo-res.</td>
</tr>
<tr>
<td>&amp;MOSAIC,1 &amp;MOSAIC,2</td>
<td>Converts a picture on hi-res page 1 or 2 to a 40 x 48 grey scale mosaic.</td>
</tr>
<tr>
<td>&amp;S1 (text1) &amp;S2 (text2) &amp;S3 (lo-res 1) &amp;S4 (lo-res 2) &amp;S5 (hi-res 1) &amp;S6 (hi-res 2)</td>
<td>Synchronous screen switches used for flipping pages.</td>
</tr>
<tr>
<td>&amp;I1,X</td>
<td>Split screen into text and hi-res 1</td>
</tr>
<tr>
<td>&amp;I2,X</td>
<td>Split screen into text and hi-res 2</td>
</tr>
<tr>
<td>&amp;I3,X</td>
<td>Split screen into hi-res 1 and hi-res 2</td>
</tr>
<tr>
<td>&amp;SEI</td>
<td>Sets the interrupt disable flag</td>
</tr>
<tr>
<td>&amp;CLI</td>
<td>Resets the interrupt disable flag</td>
</tr>
</tbody>
</table>
Still Using a “Model T” TV/Game Antenna Switch?

Electronic circuit automatically switches a TV antenna input to video game or computer and back.

By Gary Kloesz, Motorola, Inc.

TV receivers are commonly used as a means of displaying the outputs of video games and personal computers. To prevent interference with neighbors’ TV reception, it is imperative that an FCC-approved isolation switch be used, of course. This requires the user to manually move a switch lever to the desired source.

Invariably, the user forgets to switch back to the TV position after using another device. Therefore, when another person switches on the set, he or she sees only picture “snow” until the switch is moved to its TV position. This bothersome situation can be eliminated with the use of the automatic electronic switch presented here.

Circuit Operation. The key to this electronic circuit is the MPN3401 PIN diode. This type of diode can switch from a low-value resistor to a low-value capacitor depending on whether it is turned on or off. The circuit in Fig. 1 uses this property either to conduct (low resistance) or block (small capacitance) the incoming signal.

To pass a signal from the antenna input to the output, diodes $D_1$ and $D_2$ are turned on. At the same time $D_3$ and $D_4$ are off, resulting in a high impedance to the unwanted
ATARI Ln, 400 W16K *269 o 32K $349 48K $429

410 Recorder... $76.00
810 Disc Drive... $449.00
822 Printer... $269.00
825 Printer... $589.00
830 Modem... $150.00
820 Printer... $259.00
850 Interface... $169.00
CX40 Joystick... $18.00
CX853 16K RAM... $77.95

Microtek 16K RAM... $74.95
Ramdisk (128K)... $429.95
Itc 48K Board... $159.00
Itc 32K... $74.00
One Year extended warranty... $70.00
481 Entertainer... $69.00
482 Educator... $130.00
483 Programmer... $49.00
484 Communicator... $344.00

C B S ROM CARTRIDGE GAMES FOR YOUR ATARI

Krazy Shoot Out... $32.00
K-razy Knitters... $32.00
K-razy Antics... $32.00
K-star patrol... $32.00

STICK STAND $6.99

ARCADE ACTION FROM YOUR ATARI JOYSTICK

Jawbreaker... $27.00
Softporn... $27.00
Wizard and Princess... $29.00
The Next Step... $22.00
Mission Asteroid... $22.00
Mouseattack... $31.00

FILE MANAGER 800...
Chicken... $26.00
Dodge Racer... $26.00
Synthesizer... $30.00
Page 8... $19.00
Shamus... $26.00
Protector... $26.00
Noah's... $26.00
Time... $26.00
Disk Manager... $24.00

ON-LINE

SYNAPSE

TIMEX

TIMEX SINCLAIR 1000

LOWEST PRICE EVER $89.99

TIMEX DISKS

MINI DISKS

MD I (box of 10)... $36.00
MD II (box of 10)... $46.00
MD II (8"")... $44.00
MD II (8" Double Density)... $54.00
Syncom (box of 10)... $21.00

COVERS CONTAIN ADVERTISING
64K Personal Computer
Hardware, software and peripheral compatible with the Apple II and even has some features not found on the Apple.

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP-85</td>
<td>$1969</td>
</tr>
<tr>
<td>HP-125</td>
<td>$1969</td>
</tr>
<tr>
<td>BP-85 16K Memory Module</td>
<td>$169.00</td>
</tr>
<tr>
<td>51/4&quot; Dual Master Disk Drive</td>
<td>$1799.00</td>
</tr>
<tr>
<td>Hard Disk w/ Floppy</td>
<td>$434.00</td>
</tr>
<tr>
<td>Hard Drive</td>
<td>$354.90</td>
</tr>
<tr>
<td>&quot;Sweet Lips&quot; Plotter</td>
<td>$1199.00</td>
</tr>
<tr>
<td>80 Column Printer</td>
<td>$849.00</td>
</tr>
</tbody>
</table>

PROFESSIONAL SOFTWARE
Word Pro 5+ | $315.00 |
Word Pro 4+ | $295.00 |
Word Pro 3+ | $195.00 |
The Administrator | $370.00 |
IntellPro Plus | $215.00 |
Power | $75.00 |

PC 1500
POCKET COMPUTER
ALSO AVAILABLE:
Printer w/cassette interface
cassette tape recorder
and 4K and 8K RAM EXTENSIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 41C</td>
<td>$149.00</td>
</tr>
<tr>
<td>HP 41C</td>
<td>$249.00</td>
</tr>
<tr>
<td>HP 10C</td>
<td>$69.00</td>
</tr>
<tr>
<td>HP 11C</td>
<td>$79.00</td>
</tr>
<tr>
<td>HP 12C</td>
<td>$114.00</td>
</tr>
<tr>
<td>NEW 115C</td>
<td>$119.00</td>
</tr>
<tr>
<td>NEW 16C</td>
<td>$125.00</td>
</tr>
</tbody>
</table>

In-stock items shipped same day you call. No risk, no deposit on C.O.D. orders. Pre-paid orders receive free shipping within the continental United States with no waiting period for certified checks or money orders. Add 3% (minimum $3.00) shipping and handling on all C.O.D. and Credit Card orders. NV and PA residents add sales tax. All items subject to availability and price change. NOTE: We stock manufacturer's and third-party software for most all computers on the market! Call today for our new catalog.

COMMODORE BUSINESS MACHINES

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBM 64</td>
<td>CALL</td>
</tr>
<tr>
<td>4032</td>
<td>$749.00</td>
</tr>
<tr>
<td>8096 Upgrade Kit.</td>
<td>$359.00</td>
</tr>
<tr>
<td>Super Per.</td>
<td>$1599.00</td>
</tr>
<tr>
<td>2031</td>
<td>$359.00</td>
</tr>
<tr>
<td>8200 Double Sided Disk Drive</td>
<td>$1999.00</td>
</tr>
<tr>
<td>8090 5 Megabyte Hard Disk</td>
<td>$2999.00</td>
</tr>
<tr>
<td>8090 7.5 Megabyte Hard Disk</td>
<td>$2999.00</td>
</tr>
<tr>
<td>8020...</td>
<td>$1299.00</td>
</tr>
<tr>
<td>8040...</td>
<td>$959.00</td>
</tr>
<tr>
<td>6300 (Letter Quality)</td>
<td>$1549.00</td>
</tr>
<tr>
<td>8032...</td>
<td>$999.00</td>
</tr>
<tr>
<td>Pet to IEEE Cable.</td>
<td>$37.00</td>
</tr>
<tr>
<td>IEEE to IEEE Cable</td>
<td>$46.00</td>
</tr>
<tr>
<td>Tractor Fed for 8200.</td>
<td>$240.00</td>
</tr>
<tr>
<td>New Z-Ram, Add $95.00 for 64K Ram...</td>
<td>$549.00</td>
</tr>
</tbody>
</table>

ADDITIONAL MANUFACTURER'S DISCOUNTS AVAILABLE TO QUALIFIED EDUCATIONAL INSTITUTIONS

800-233-8950 east
signal from the game/computer input. To attenuate the unwanted signal further, D6 is also turned on. This creates a low resistance to ground between D3 and D4. Figure 2 illustrates the ac path when the antenna, or A, input is selected.

An advantage of this type of switch is that it can be activated through remote control. For example, turning on the game or computer can automatically “throw” the switch. The switching signal is supplied by the game or computer. It is simply a dc voltage of 5 to 10 V, which is found on the switched side of the game/computer power supply. The signal is transmitted via the cable that connects the game/computer to the TV set. Another advantage is that an electronic device is immune to problems caused by dust, dirt, and wear. There is one disadvantage, however. This switch requires a minimum of 5 mA continuous power to operate because one set of diodes is always on.

With regard to FCC requirements, the electronic switch meets them easily. It provides low (0-dB) insertion loss and high isolation (60 dB) between inputs as shown in the oscilloscope photos of Fig. 3.

**Construction.** The antenna switch can be constructed on a pc board. The foil pattern is shown in Fig. 4, with the corresponding parts-placement diagram given in Fig. 5. Since this is an r-f circuit, take care to leave as much ground plane as possible and to trim component leads short. If desired, enclose the circuit in a box.

For remote control switching, a dc blocking capacitor must be added to the cable that connects the game or computer to the antenna switch. It should be added at the game/computer end to isolate the switching voltage from the modulator output. Also a 1-kilohm resistor should be connected as shown in Fig. 6. These two components should be housed in a separate adapter box. If the automatic switching feature is not required, the transistor network can be replaced by an ordinary dpdt switch (Fig. 7).

The power supply for the switch can be any 5-to-10-V, calculator-
You get the COMMODORE VIC-20 Computer for only $169.00! For the SPECIAL SALE PRICE OF $259.00 you get the COMMODORE VIC-20 computer plus WE ADD 3000, BYTES OF MEMORY to give you 60% MORE PROGRAMMING POWER! This powerful full-sized extra featured computer includes the 6502 microprocessor (LIKE APPLE), 20,000 byes RAM with a 16K extended LEVEL II Microsoft BASIC, 8000 bytes RAM plug in expandable to 2,000 bytes RAM, a $89.70) GAME program pack, a $169.00 power typewriter professional expanded keyboard with graphic symbols on keys, color command keys, high resolution graphics, 512 programmable characters, text display is 22 lines 23 characters, sound and music, real time, upper lower case, full screen editing cursor, floating point decimal and trig functions, string arrays, scrolling, multi statement lines, file management, PEEK AND POKE. Assembly machine language is available. We have easy to use self teaching books and programs. Accepts TAPE-DISK-PLUG IN CARTRIDGES, connects to any TV, includes AC adapter, switch box, self teaching instruction book, comes in a beautiful console case.

LOW COST PLUG IN EXPANSION
Expansion accessories plug directly into this computer, extra RAM memory, Controllers, a Cassette, A Telephone Modem (for only $89.00), an 80 Column Printer for $349.00, even the 170K Disk Drive plugs in direct. You do not have to buy an expensive expansion unit.

WHY SUCH A LOW PRICE
YOU WON'T BEAT OUR PRICES FOR THE COMMODORE VIC-20 COMPUTER with tape programs or with increased programming power added! We sell direct to customers and you save the profit margin normally made by computer stores, department stores and distributors. We are willing to take a smaller margin to develop volume!

INVEST IN YOUR CHILDREN
Educate your children while they play. Every kid wants to play electronic games. (We have some of the best.) The next natural step for their curiosity is to try simple programming. They can do this in 20 minutes with our simple self teaching instruction book. High schools are teaching computer math, science and programming, some start in grammar school. If you provide this computer as a Teacher and Tutor at home, before you know it your child will be writing computer programs. We have over 500 programs to choose from! More than 270 educational programs for the teaching of small business and home programs, plus a wide variety of the best games! Why pay $140.00 to $295.00 for an electronic game or $100.00 for a 2K toy computer with a flat plastic keyboard? When you can buy this powerful extra featured computer for only $169.00.

IMMEDIATE REPLACEMENT WARRANTY
If your computer fails because of warranty defect within 90 days from date of purchase, you simply send your computer to us via United Parcel Service prepaid. We will "immediately" send you a replacement computer at no charge via United Parcel Service prepaid. No one we know gives you this kind of warranty service. Most computer warranty service takes 30 to 90 days to handle. This fantastic "immediate replacement warranty" is backed by COMMODORE COMPUTER, a MAJOR national brand electronics manufacturer.

SPECIAL SALE PRICE $259
For only $259 you get POWERFUL 28K COMMODORE VIC with 60% MORE PROGRAMMING POWER THAN VIC-20! It has 28,000 bytes total memory (20,000 bytes ROM, 8,000 bytes RAM and extended LEVEL II BASIC) plus all the extra features listed.

SPECIAL SALE PRICE $339
For only $339 you get SUPER POWERED 41K COMMODORE VIC with 400% MORE PROGRAMMING POWER THAN VIC-20! We add 16,000 bytes memory to the VIC-20. You get a total of 41,000 bytes memory (20,000 bytes ROM, 21,000 bytes RAM and extended LEVEL II BASIC) plus all the extra features listed!

TRACTION-FRICTION PRINTER $399
This all new COMMODORE deluxe line printer, prints 80x11 letter quality full size, single or fan fold paper, labels and etc. 40, 66, 80, 312 columns. Includes cable that plugs directly into the VIC-20 printer port - no other interface is needed. List $599. Sale $399.

15 DAY FREE TRIAL

DON'T MISS THIS SALE - ORDER NOW

☐ Please send me the COMMODORE VIC-20 for $169.00 plus $89.70 for 6 tape programs

☐ Please send me the 28K COMMODORE VIC for only $259.00.

☐ Please send me the 41K COMMODORE VIC for only $339.00.

☐ Please send me the TRACTION-FRICTION PRINTER for only $399.00.

We ship C.O.D. and honor Visa and Master Card.

Name _________________________

Address ___________________________

City ____________________________

State ___________ Zip Code ________

☐ VISA ☐ VISA/MASTERCARD ☐ C.O.D.

Credit Card No. __________________

Expiration Date ____________

Add $10.00 for shipping, handling and insurance. Illinois residents please add 6% tax. Add $20.00 for CANADA, PUERTO RICO, HAWAII orders. WE DO NO EXPORT TO OTHER COUNTRIES. Enclose Cashier’s Check, Money Order or Personal Check. Allow 14 days for delivery. 2 to 7 days for phone orders, 1 day express mail! Canada orders must be in U.S. dollars.

TRACTION-FRICTION PRINTER $399
This all new COMMODORE deluxe line printer, prints 80x11 letter quality full size single or fan fold paper, labels and etc. 40, 66, 80, 312 columns. Includes cable that plugs directly into the VIC-20 printer port - no other interface is needed. List $599. Sale $399.

15 DAY FREE TRIAL

DON'T MISS THIS SALE - ORDER NOW

☐ Please send me the COMMODORE VIC-20 for $169.00 plus $89.70 for 6 tape programs

☐ Please send me the 28K COMMODORE VIC for only $259.00.

☐ Please send me the 41K COMMODORE VIC for only $339.00.

☐ Please send me the TRACTION-FRICTION PRINTER for only $399.00.

We ship C.O.D. and honor Visa and Master Card.

Name _________________________

Address ___________________________

City ____________________________

State ___________ Zip Code ________

☐ VISA ☐ VISA/MASTERCARD ☐ C.O.D.

Credit Card No. __________________

Expiration Date ____________

Add $10.00 for shipping, handling and insurance. Illinois residents please add 6% tax. Add $20.00 for CANADA, PUERTO RICO, HAWAII orders. WE DO NO EXPORT TO OTHER COUNTRIES. Enclose Cashier’s Check, Money Order or Personal Check. Allow 14 days for delivery. 2 to 7 days for phone orders, 1 day express mail! Canada orders must be in U.S. dollars.

TRACTION-FRICTION PRINTER $399
This all new COMMODORE deluxe line printer, prints 80x11 letter quality full size single or fan fold paper, labels and etc. 40, 66, 80, 312 columns. Includes cable that plugs directly into the VIC-20 printer port - no other interface is needed. List $599. Sale $399.

15 DAY FREE TRIAL

DON'T MISS THIS SALE - ORDER NOW

☐ Please send me the COMMODORE VIC-20 for $169.00 plus $89.70 for 6 tape programs

☐ Please send me the 28K COMMODORE VIC for only $259.00.

☐ Please send me the 41K COMMODORE VIC for only $339.00.

☐ Please send me the TRACTION-FRICTION PRINTER for only $399.00.

We ship C.O.D. and honor Visa and Master Card.

Name _________________________

Address ___________________________

City ____________________________

State ___________ Zip Code ________

☐ VISA ☐ VISA/MASTERCARD ☐ C.O.D.

Credit Card No. __________________

Expiration Date ____________

Add $10.00 for shipping, handling and insurance. Illinois residents please add 6% tax. Add $20.00 for CANADA, PUERTO RICO, HAWAII orders. WE DO NO EXPORT TO OTHER COUNTRIES. Enclose Cashier’s Check, Money Order or Personal Check. Allow 14 days for delivery. 2 to 7 days for phone orders, 1 day express mail! Canada orders must be in U.S. dollars.

TRACTION-FRICTION PRINTER $399
This all new COMMODORE deluxe line printer, prints 80x11 letter quality full size single or fan fold paper, labels and etc. 40, 66, 80, 312 columns. Includes cable that plugs directly into the VIC-20 printer port - no other interface is needed. List $599. Sale $399.

15 DAY FREE TRIAL

DON'T MISS THIS SALE - ORDER NOW

☐ Please send me the COMMODORE VIC-20 for $169.00 plus $89.70 for 6 tape programs

☐ Please send me the 28K COMMODORE VIC for only $259.00.

☐ Please send me the 41K COMMODORE VIC for only $339.00.

☐ Please send me the TRACTION-FRICTION PRINTER for only $399.00.

We ship C.O.D. and honor Visa and Master Card.

Name _________________________

Address ___________________________

City ____________________________

State ___________ Zip Code ________

☐ VISA ☐ VISA/MASTERCARD ☐ C.O.D.

Credit Card No. __________________

Expiration Date ____________

Add $10.00 for shipping, handling and insurance. Illinois residents please add 6% tax. Add $20.00 for CANADA, PUERTO RICO, HAWAII orders. WE DO NO EXPORT TO OTHER COUNTRIES. Enclose Cashier’s Check, Money Order or Personal Check. Allow 14 days for delivery. 2 to 7 days for phone orders, 1 day express mail! Canada orders must be in U.S. dollars.

TRACTION-FRICTION PRINTER $399
This all new COMMODORE deluxe line printer, prints 80x11 letter quality full size single or fan fold paper, labels and etc. 40, 66, 80, 312 columns. Includes cable that plugs directly into the VIC-20 printer port - no other interface is needed. List $599. Sale $399.
type, plug-in, dc power supply such as a 9-V battery eliminator.

The switch is designed for a 75-ohm antenna system. If you have a 300-ohm system, matching transformers are required at both the antenna input and TV output. The game/computer input does not require a matching transformer because it is already a 75-ohm source.

Connect the switch to your system as shown in Fig. 8. You're now ready to watch TV or run your microcomputer or video game. Whichever you choose, your TV will give you the proper display automatically and you won't have to switch the antenna.
**COMPUTER BOOKS FOR BEGINNERS**

Everything you need to get started programming your own personal computer. These handy books of programs, and about programming, are loaded with easy-to-understand info for beginners. The books include hundreds of ready-to-type-and-run programs as well as hundreds of program-writing tips, tricks, hints, shortcuts, secrets, techniques. We offer books covering the 13 most popular computers for beginners: TRS-80 Color Computer, Atari 400, Atari 800, Apple II, Sinclair ZX-81, Timex 1000, Micro Ace, IBM Personal Computer, Casio FX-702P pocket computer, Sharp PC-1211 and PC-1500 pocket computers and TRS-80 PC-1 and PC-2 pocket computers.

**Atari 400/800 Computers**

101 **Atari Computer Programming Tips & Tricks**, learn-by-doing instruction, hints, secrets, shortcuts, techniques for Atari 400 and 800 computers, includes 101 ready-to-run programs. 128 pages $8.95

31 **New Atari Computer Programs for Home, School & Office**, practical type-and-run software for Atari 400 and 800. 96 pages $8.95

**Timex 1000/Sinclair ZX-81**

101 **TIMEX 1000/Sinclair ZX-81 Programming Tips & Tricks**, secrets, hints, shortcuts, learn-by-doing instruction, techniques for the ZX-81. MicroAce and Timex 1000 computers, includes 101 ready-to-run programs. 128 pages $7.95

37 **TIMEX 1000/Sinclair ZX-81 Computer Programs for Home, School & Office**, practical type-and-run software for ZX-81, Timex 1000 and MicroAce. 96 pages $8.95

**TRS-80/Sharp/Casio Pocket Computers**

99 **Tips & Tricks for the New Pocket Computers**, all new programs, using tremendous power of TRS-80, PC-2/Sharp PC-1500, LCD graphics, printer/plotter graphics, useful business and home software, includes 99 complete type-and-run programs, learn full range of expanded BASIC. 128 pages $7.95

**Pocket Computer Programming Made Easy**, fast new easy read-and-learn way to quickly understand the BASIC programming language, how to make TRS-80 PC-1/PC-2, Sharp PC-1211/PC-1500 & Casio FX-702P computers work for you. 128 pages $8.95

101 **Pocket Computer Programming Tips & Tricks**, secrets, hints, shortcuts, techniques from a master programmer, includes 101 ready-to-run programs, for TRS-80 PC-1 and PC-2 and Sharp PC-1211 and PC-1500. 129 pages $7.95

50 **Programs in BASIC for Home, School & Office**, useful ready-to-run software for PC-1/PC-2/PC-1211/PC-1500. 96 pages $9.95


**Murder In The Mansion and Other Computer Adventures**, mystery, space adventure, games, 24 programs for PC-1/PC-2/PC-1211/PC-1500. 96 pages $8.95

35 **Practical Programs for the Casio Pocket Computer**, useful type-and-run software for the FX-702P. 96 pages $8.95

**Apple Computer**

101 **APPLE Computer Programming Tips & Tricks**, secrets, hints, insights, 101 ready-to-run programs for Apple II. 128 pages $8.95

33 **New APPLE Computer Programs for Home, School & Office**, practical type-and-run software for Apple II. 96 pages $8.95

**TRS-80 Color Computer**

101 **Color Computer Programming Tips & Tricks**, learn-by-doing instructions, hints, secrets, techniques, insights, for TRS-80 Color Computer, includes 101 programs. 128 pages $7.95

55 **Color Computer Programs for Home, School & Office**, practical ready-to-run software, colorful graphics, for TRS-80 Color Computer. 128 pages $9.95

55 **MORE Color Computer Programs for Home, School & Office**, handy companion volume packed with different useful type-and-run software, colorful graphics, for TRS-80 Color Computer, 112 pages $9.95

**Color Computer Graphics**, complete guide loaded with instruction, how to make the most of TRS-80 Color Computer video graphics, many complete programs, 128 pages $9.95

**The Color Computer Songbook**, 40 favorite pop, folk, classical, seasonal songs arranged for play on TRS-80 Color Computer, type-and-run music programs, 96 pages $7.95

**My Buttons Are Blue and Other Love Poems from the Digital Heart of An Electronic Computer**, for poetry lovers, computer fans, a high-tech classic, 66 heartwarming poems written by a TRS-80 Color Computer, 96 pages $4.95

**Program Worksheets**

Tablets of handy printed forms make writing BASIC software easy and fun. Customized for computer systems, or use the universal form good for any BASIC computer. 40-sheet pads.

IBM Personal Computer Coding Form $2.95

ATARI Computer BASIC Coding Form $2.95

Color Computer BASIC Coding Form $2.95

Pocket Computer BASIC Coding Form $2.95

APPLE Computer BASIC Coding Form $2.95

TIMEX/Sinclair BASIC Coding Form $2.95

Universal BASIC Coding Form $2.95

Order direct from this ad. Send check, money order, or MasterCard or VISA account number and expiration date. Include $1 shipping for each item ordered up to a maximum of $3. Or write for our free catalog. Mail to:

**AARCsoft Publishers**

Post Office Box 132A

Woodsboro, Maryland 21798

(301) 663-4444

Customers wanting airmail send $4 postage per item ordered. Foreign customers pay in U.S. dollars. Maryland residents add 5% sales tax. Sorry, no C.O.D.
EQUIPMENT AND TRAINING
NO OTHER SCHOOL CAN MATCH.

NTS HOME TRAINING INVITES YOU TO EXPLORE MICROCOMPUTERS, DIGITAL SYSTEMS AND MORE, WITH STATE-OF-THE-ART EQUIPMENT YOU ASSEMBLE AND KEEP.

Without question, microcomputers are the state of the art in electronics. And NTS is the only home study school that offers you training for this booming field with a choice of 3 production-model micro computers.

We'll explain the principles of troubleshooting and testing your microcomputer and, best of all, we'll show you how to program it to do what you want.

You'll use a digital multimeter, a digital logic probe and other sophisticated testing gear to learn how to localize problems and solve them.

Send for the full color catalog in the electronics area of your choice—discover all the advantages of home study with NTS!

NTS also offers courses in Auto Mechanics, Air Conditioning and Home Appliances. Check card for more information.

We believe that training on production-model equipment, rather than home-made learning devices, makes home study more exciting and relevant. That's why you'll find such gear in most of NTS's electronic programs.

For instance, to learn Color TV Servicing you'll build and keep the 25" (diagonal) NTS/HEATH digital color TV.

In Communications Electronics you'll be able to assemble and keep your own NTS/HEATH 2-meter FM transceiver, plus test equipment.

But no matter which program you choose, NTS's Project Method of instruction helps you quickly acquire practical know-how.
1. The NTS/Rockwell AIM 65 Dedicated Microcomputer A single board unit featuring on-board printer and display—4K RAM (expandable). Application Functions: Central processor—Controller/Monitor—Development System. 2. The NTS/SYM-1 Microcomputer 6502 Based CPU—4K bytes ROM (expandable)—1K RAM (expandable). 51 active I/O lines for versatile interfacing: disk drives, ASCII key boards, cassette tape, etc.

3. The NTS/Heath HN-89A Microcomputer features floppy disc storage, "smart" video terminal, two 80 microprocessors, with 32K RAM Memory, expandable to 64K on board. 4. The NTS/Heath GR 2001 Digital Color TV (25" diagonal) features specialized AGC-SYNC muting, filtered color and new solid-state high voltage tripler rectifier.

**Simulated TV Reception**
COMPUTER CLONES

Comparing computer variations with their originals—TRS-80 Apple II, and IBM-PC

By Stan Veit
Technical Editor

IMITATION is the sincerest form of flattery, the saying goes. But don't expect makers of personal computers that dominate the field to look kindly on computer "clones" of their products. These functional copies run the same software as the originals and, in most cases, interface easily with the same peripherals. Are the copycat machines cheap imitations? Are they better than the originals? To answer these and other questions, here are the results of our detailed examination of many such models.

TRS-80 Clones

Tandy's TRS-80 Model I was a pioneer product that quickly spread the personal computer gospel across the nation through its easy sales availability in many thousands of Radio Shack stores. The machine's great popularity spurred an enormous number of small entrepreneurs to develop and sell software programs for use with the Mod I. And hardware makers took advantage of some of the Mod I's design shortcomings by making available select improvements such as adding lower-case letters, making cassette-tape loading easier, etc. Better or less costly peripherals for the Mod I were also developed by independents.

As time progressed, Radio Shack began to catch up with improvements and enhancements for the Mod I, until it was finally displaced by the company's Model III, which might be considered an upgraded, all-in-one Model I.

Meanwhile, other brands that use the same software material sprang up to emulate Radio Shack's original products. Here are what two leading types are all about.

The PMC-80 Computer. The PMC-80 is a TRS-80 Mod I clone that is made in Hong Kong and imported into the United States by Personal Microcomputers of Mountain View, CA. It is a Z80-based computer that is functionally identical to the TRS-80 Mod I but has no physical resemblance to the Radio Shack computer. The console unit has simulated wood sides and a front panel on which are mounted the keyboard and a built-in cassette recorder. It includes either 16K or 4K of RAM memory. There is also a PMC-81 model that includes a numerical keypad in place of the built-in cassette recorder. Since both machines are otherwise identical, we shall only discuss the PMC-80.

Although there is a video interface supplied with the computer, no video display comes with the machine. The user can employ either a monochrome video monitor or a built-in r-f modulator and a TV set. This dual output concept is also carried over to the cassette mass storage facility. There is a DIN connector on the rear panel to connect the standard Radio Shack TRS-80 cassette cable. This is used to connect an additional recorder or, in the case of the PMC-81, the prime recorder.

The PMC-80 allows for a choice of two video formats. There is a 64-character display and an enlarged 32-character display for use with TV sets. The selection of video formats is done with the VIDEO CUT button on the rear panel. When the computer is turned on, the 64-char-
Let's get

try out the in-stock selection of Heath/Zenith microcomputers, peripherals, accessories and software.

Now available at your nearby Heathkit Electronic Center, or through the Heathkit mail order catalog.

You get more with a Heath/Zenith personal microcomputer system! We offer:
personal...

1. Proven, high-performance hardware: Thousands of our microcomputers are proving themselves daily, in the field.

2. Vast software library: Three operating systems (including CP/M), languages, word processors, an electronic spreadsheet, versatile utilities and the 500-program Heath Users' Group software library.


4. Service support: Before and after the sale — consultation by phone, carry-in service.

Test run one of our microcomputers at any of the more than 60 convenient Heathkit Electronic Centers in the U.S.

Heathkit
ELECTRONIC CENTERS

See the white pages of your telephone book for store locations and telephone numbers.

*Units of Veritechology Electronics Corporation in the U.S.

Or if you prefer, send to the address below for a
FREE catalog:

Heath Company
Dept. 310-954
Benton Harbor, MI 49022

In Canada: Heath Company
1480 Dundas St. E.
Mississauga, ONT L4X 2R7

Please send my free catalog, describing your complete line of microcomputer products!

Name
Address
City ________ State ________
CP-214 Zip ________

CIRCLE NO. 28 ON FREE INFORMATION CARD
character display is in force. When the video cut button is pressed, the 32-character format is selected. In this mode, the page button on the front will select either of two possible pages of video display.

The keyboard includes the following special function keys:

PAGE—Displays either the left half or the right half of the video display when in 32-character format.

F<sub>1</sub>—Controls the cassette recorder and isolates it from the computer during fast-forward and rewind operations.

BREAK—Stops program execution and returns control to the active command mode.

NEWLINE—Enters line of program or data.

BACKSPACE— Cancels the character previously typed.

The cassette recorder mounted on the front panel is equipped with a three-digit counter and a VU meter for setting the audio level during record or playback. The latter greatly improves data loading accuracy. The optional secondary data recorder is used to read data files into the machine and record them on another file after processing. The quality of the built-in recorder surprised and pleased us. We loaded commercial tapes from several software publishers and tapes we had made on another recorder. Using the VU meter as a guide, we were able to load the programs and data without a single bad load! Using the secondary cassette recorder (one we used with a TRS-80 Mod I) we had some trouble setting the level; but once set, the loads were very reliable.

Both memory expansion and I/O are accomplished by connecting the computer to the company's EXP-100 Experander, the same method used with the old Mod I's interface adapter. The Experander has provisions for adding additional RAM memory, external disk memory, and I/O devices. Sixteen sockets have been provided to permit the installation of 4116 dynamic RAM chips to expand the internal memory from 16K to 48K, the maximum the system can use. This is identical to the TRS-80 Mod I.

The memory map of the PMC-80 uses memory area from $0000 to $2FFF (0 to 12,287) for ROM-based programs such as the system monitor and Microsoft BASIC. The area from $37FFF to $3800 (14,335 to 14,336) is used for the keyboard. The video display area occupies the memory locations from $3C00 to $3FFF (15,360 to 16,383), while 16K of RAM in the computer unit is located from 3FFF to 7FFF.

The PMC Experander interface can handle from one to four single-sided drives. It can also be wired to handle double-sided drives; but in that case, one double-sided drive takes the place of two single-sided drives. The disk drives offered by PMC are made in Japan by TEC. They are 40-track units capable of 102K of formatted data in single-density or 184K of formatted data in double-density. The PMC company does not sell a doubler for double-density, but either the one made by Percom or the one made by LNW can be used. The interface does have a built-in data separator, which corrects a major deficiency in the Radio Shack TRS-80 Mod I. We found the TEC drives to be quiet and reliable.

The parallel interface in the expander is Centronics compatible and works with all of the popular printers with this type of interface. We used it with Epson printers and with the TP-1 from Smith Corona. If an RS-232C interface is needed, it is supplied as a $95 option. The PMC bidirectional serial interface is a board that plugs into the Experander main board and features the ability to set the baud rate in software. Another interesting option available with the Experander is the S-100 board interface. This provides slots for two S-100 cards. Personal Micro Computers Inc. supplies manuals printed by the manufacturer in Hong Kong. They are adequate for setting up the system and for operation, but offer no technical details for maintenance.

We liked using the PMC-80 Computer. It loaded software from both disk and cassette without errors and repeats. A person who is used to the original would feel completely at home with this machine, and one just starting with comput-
Franklin's ACE 1000 Runs With The Best!

VisiCalc®, DB Master®, Desktop Plan®—they are all running on the Franklin ACE 1000. Cash flow, budgets, word processing or data base management, business or pleasure, the ACE 1000 runs with the best.

The Franklin ACE 1000 is hardware and software compatible with the Apple® II. Franklin users can choose from an enormous selection of programs—programs that run better on the ACE because it includes 64K of RAM, upper and lower case, VisiCalc keys, a numeric pad and an alpha lock key.

Run with the best. Call or write today for the name of your local authorized Franklin dealer.

Franklin ACE is a trademark of Franklin Computer Corporation. Apple is a registered trademark of Apple Computer Inc. VisiCalc and Desktop Plan are registered trademarks of Visi Corp. DB Master is a registered trademark of Stoneware.
ers should have no trouble setting up and using this system. There's no doubt that the PMC-80 is significantly better than the TRS-80 Mod I was. However, since the I is no longer available, one has to pit the PMC-80 against the TRS-80 Model III.

Total price of the units required to equal the capabilities of the TRS-80 Mod III comes to a little over $2000. This is just $225 less than the price of a TRS-80 Mod III at the local Radio Shack store. While the PMC-80 may sell for a lower price at its dealers, it seems to us that it lacks one important feature: the support that one gets from Radio Shack. The manuals, availability of repair service, and software support are worth a lot of bucks to many people.

The LNW80 Computer. Whereas the PMC-80 is a clone of the TRS-80, the LNW80 can be considered as the answer to the wish list of the owner of a TRS-80 Mod I or III. This machine was designed to supply all of the nice things that are lacking in both TRS-80's. In fact it can compete on some counts with the TRS-80 Mod II. It is a machine that can be many things to different people. For the new user, it can be a cassette-based beginning computer complete with built-in Microsoft BASIC and with the capacity to grow with the experience of the user. For the advanced TRS-80 users, it is a computer that will give color graphics, and the possibility of using 8" disk drives without giving up the operating system and software they are used to.

Physically, the LNW80 is a neat metal-cased machine with a full keyboard (upper/lower case) including a 12-key numeric keypad. All the connectors and switches are located on the rear panel and they include both parallel and RS-232C serial connectors, video outputs for monochrome, NTSC color and RGB color. The floppy-disk system has both single- and double-density controllers and provisions for either 5 1/4" or 8" drives. It is designed to run any of the popular disk operating systems that have been written for the TRS-80 computers. Furthermore, it will also run either Mod I or Mod III software. The cassette storage system will operate at either 500 or 1000 baud, and can use the same cassette...
The LNW80 has three versions of the BASIC language available and they can be used for different conditions. First, there is Microsoft Level II BASIC, which is in the 12K ROM. This is identical to the Level 2 used in Radio Shack TRS-80 computers. The second BASIC is a DOSPLUS 3.4 Tiny BASIC, which is on the DOSPLUS diskette. It provides an extension to the Level 2 BASIC and adds disk file handling, advanced keyboard I/O, in-string search commands, and user-defined BASIC commands. DOSPLUS Extended Disk BASIC is also on diskette and it adds other features to the DOSPLUS BASIC.

LNWBASIC is supplied on a separate single-density diskette and it provides 40 additional commands to the other BASIC versions. It is the language that controls the high-resolution graphics and color, machine-language calls, sound commands, print spooler, RS232 communications from BASIC, and do/until constructs. It is LNWBASIC that gives this computer much of its power! Although DOSPLUS is supplied with an LNW disk system, the computer is capable of running NEWDOS, NEWDOS80 or LDOS, as well as TRSDOS.

Video display of the LNW80 may be either an RGB color monitor, an NTSC color monitor, or a high-quality monochrome monitor. An r-f modulator and a TV receiver can also be used with reduced screen width. The computer has the capability of displaying 80 characters by either 16 or 24 lines; 40 characters by either 16 or 24 lines; 64 characters by 24 lines; or 32 characters by 24 lines. The exact video display format depends upon the selection of software. The 80- and 40-character displays are only

recorder and cable supplied with the Radio Shack computers.

Internally, the LNW80 uses a Z80 microprocessor with a 4-MHz clock. Interestingly there is a switch on the rear panel to reduce clock speed so that the computer can run the TRSDOS operating system from Radio Shack which is designed to run with a 1.77-MHz clock. The LNW80 is equipped with 48K of user RAM memory and a 12K ROM containing the Microsoft BASIC interpreter and 1K for the video screen. In the graphics mode the BASIC is switched out and 16K is used for graphics.
available to users of disk operating systems when the applicable driver programs are run. In addition, these drivers have limitations—they cannot be used in word-processing applications unless the software has been specially configured for that purpose.

The LNW80 is equipped to display both upper- and lower-case characters without modification once the proper driver programs are executed. This does not apply to the use of any of the standard disk operating systems or word-processing software systems that have their own internal drivers for the upper/lower case functions.

The LNW80 Computer has the capacity to use up to four disk drives. These may be either 5 1/4" or 8" drives, a combination of both, or even hard disk drives. Dual-headed drives (two read/write heads) may also be used; but in this case, only three disk drives can be connected. The diskettes may be formatted for either single- or double-density. This gives users who have accumulated a great deal of single-density software the ability to expand from the original TRS-80 Mod I or Mod III. The possibility of using existing software and at the same time expanding disk capacity is one of the most attractive features of the LNW80. It can also operate with any of the popular disk operating systems such as TRSDOS, DOSPLUS, NEWDOS, MULTITDOS, LDOS, and VTOS.

The LNW80 is not a cheap computer. It is thoughtfully designed and well made in the United States. The basic computer unit, which includes 48K user RAM, the disk controller, upper/lower-case keyboard, complete data and video I/O, cassette interface, and all the graphics and color features, costs $1695. To use the computer, you must add a video monitor and a disk system, plus the DOS and LNW/BASIC software. An average black-and-white system will cost over $3000 while a color monitor will add from $250 to $750 to this price. A new model that will add CP/M capability (additional memory and CP/M software) will cost $2495 for the base unit. Although there are a few dealers, at this time, the machine is sold through mail order directly by LNW Research Corporation, Tustin, CA 92680.

The LNW80 does not appear to be a machine for the first-time computer user. Features such as color and graphics are not easy to use since they require the use of specialized software to initialize and run them. However, for the software developer, graphics artist, and advanced computer hobbyist, this machine offers all the things they always wanted in a TRS-80 type of computer. We do not think the business user will find a machine with as little support as the LNW80 very practical, though. With the proper back-up from a systems house, however, this should prove to be a powerful tool that's rugged, versatile and expandable.

Apple Clones

The Apple computer was also an early entry in the personal computer stakes. Its product distribution was largely through independent retail stores. Today, the Apple II is one of the most popular and useful small computers built. It employs a 6502 microprocessor in contrast to Radio Shack's Z80 CPU, and contains a lot of complex programs in ROM that make color, graphics, and audio easy for a user to learn and apply. Until recently, though, functional copies of the Apple II were not produced. Now at least two compatible brands have appeared, as well as blatant replicas being manufactured and promoted in the Orient. Let us examine the two types promoted in the U.S., the Franklin Ace Computer and the Basis Computer.

Franklin Ace 1000. The Franklin Computer Company's Model Ace 1000 is not only a functional copy of the Apple II+, but it has also been designed to look like the Apple II+. It has almost all the features of the Apple II+ except color and a cassette interface. Moreover, it includes some features that the Apple lacks unless it is modified (like printing upper- and lower-case characters) and 64K of RAM.

To a large section of the computing public, the addition of color is "frosting on the cake." Certainly graphics and games look much better in color than in monochrome but color isn't needed for accounting applications, spreadsheet applications, or word processing; neither do file management programs or data bases. Nevertheless, a Franklin spokesman advises that all of its users who want color will have that option soon. The audio cassette was omitted because it was not considered to be an effective mass storage system for anything more complicated than games. It lacks a file structure and takes too long to load business programs.

Since Apple terminated many distributorships and mail-order retailers, there has been a ready market for the Franklin Ace Computer. The first model was the Ace 100, which was built into a standard case. Apple Computer sought an injunction to stop its sale, but that threat seems to have been eliminated by the courts. The company's new Ace 1000 features a sturdy new plastic case.

Like the Apple II+, the Ace 1000's case has a snap-off lid. Removing the lid, you will see the switching power supply on the left. It has plenty of power for all the extra boards you may plug into the computer. There is a fan built into the front of the power supply to prevent overheating.

The Ace main circuit board is somewhat larger than the Apple and it contains 64K of user RAM rather than 48K. Both units have eight slots for plug-in cards and a joystick/paddle connector for game controls.

The Ace 1000 keyboard has excellent quality and feel. It has typewriter styling and includes an illuminated Alpha shift/lock and a keypad with both numeric and special VisiCalc markings. On the left side of the keyboard are four keys marked ESC, BREAK, PAUSE, and CTRL. Locating the BREAK adjacent to the ESC key might cause problems with some software; however, the location of the CTRL key is an unfamiliar position that takes...
some time to get used to if you have some prior computer experience. There are five keys that must be typed differently on the Ace-1000 as compared to the Apple II, including some common symbols like brackets. Due to these differences and the upper/lower-case type, some Apple II programs must be re-configured to run on the Franklin computers. Thus, the user will have to check carefully before buying Apple II software for the Ace 1000. This type of minor difference can assume major proportions when software with a lot of color commands is run.

The RESET key on the Franklin Ace has been placed in a position where it is easy to get at, but impossible to hit accidentally, the latter being an annoying occurrence on the Apple. Franklin installed it on the underside of the keyboard, on the left-hand side.

The DOS supplied with a Franklin disk system is completely compatible with Apple DOS 3.3; it even has the utility to run the older 13-sector Apple diskettes. It contains both floating point BASIC (FPBASIC) and integer BASIC (INTBASIC). The copy of FPBASIC on the disk is only on the disk for diagnostic purposes since the identical BASIC is always stored in the machine. The INTBASIC is automatically loaded into the computer at power-on. Once it is read in, it usually stays in memory until the power goes off. Franklin has collected a group of utility routines into a program called FUD (Franklin Utility for Diskettes). When FUD is run, it gives the user a Main Menu from which utilities can be selected to copy, delete, lock, unlock, or verify files, and to format diskettes and make a master diskette. FUD is a very handy concept because it gives single-key entry to several interrelated programs.

We liked using the Franklin Ace. It is a well-designed computer. Of course it is much easier to "reverse-engineer" a machine to correct the faults of a model than it is to conceive a completely new design. The suggested price of the Franklin 1000 is $1530 and the disk with controller is $579. However, the actual selling price in stores is much less. The price of the Apple II with comparable equipment is about $250 higher.

**Basis-108.** The Basis-108 is an Apple II+ compatible computer since it runs Apple II software and has six slots for the use of Apple II boards. It cannot really be called an Apple copy, though, since its configuration is not based upon the Apple II design and because Apple II software is only a portion of its software library. Its features and utility go beyond what the Apple II can offer.

Basis was originally Apple Computer’s distributor in West Germany and it worked with Apple on design of a Euro-Apple that was never built. Apple took over the distributorship in Europe as they had in the United States, and Basis proceeded to produce the Basis-108 in Germany. It is sold and supported in the U.S. by Basis Inc. of Scotts Valley, CA.

The Basis-108 looks somewhat like the IBM-PC, with a rectangular computer unit having disk drives in the front. The video monitor sits on top of the computer unit and the attractive low-profile keyboard is a detached unit connected to the computer unit by a five-foot, coiled cord.

The Basis-108 is equipped with both 6502 and Z80 microprocessors, with up to 128K of RAM memory on a large main circuit board. The memory is split into two banks of 64K each and bank switched as required during processing. The system has a monitor program occupying 2K of ROM and 5 additional sockets for additional ROM or EPROMs for a total of 10K of ROM memory. There is provision for internal mounting of two disk drives. Either Apple drives or other compatible drives can be used. All the system power, video and I/O connectors are located on the rear panel. These consist of power input, two switched-power utility sockets, one DB25 connector for keyboard I/O, two DB25 connectors for system I/O, three video connectors for composite video, one DB9 connector for RGB video, and one DIN connector for cassette I/O. The rear panel also has three additional slots for extra DB25 connectors.

The low profile, detached keyboard is among the nicest of this genre we have seen. The keyboard consists of 100 keys that are divided into four groups according to function. There is the standard ANSI typewriter keyboard group, a numerical keypad, a cursor control block, and programmable function keys. The keyboard is decoded by a ROM on the main circuit board, and the keyboard configuration can be changed by changing the ROM.

The Basis-108 is compatible with Apple II+ software and runs CP/M.
The Basis-108 has a wide range of video displays. There are two text modes and three color graphic display modes. The text display can be either 40 columns by 24 lines or 80 columns by 24 lines. The graphics display can be 40 horizontal by 48 vertical with 15 colors; 80 horizontal by 48 vertical with 15 colors; or 280 horizontal by 192 vertical with 6 colors. It is also possible to have high-resolution graphics and up to four lines of text. The video display can be either black-and-white composite video, composite color video, or RGB color video. There is also a built-in loudspeaker for sounds and music programs.

The Apple DOS is supplied with the disk system; either the standard Apple DOS 3.3 can be used or one supplied by Basis that is menu driven but otherwise identical to Apple 3.3. The CP/M disk is supplied by BASIS with a BIOS designed for the BASIS-108. Microsoft BASIC is built into the system.

The Basis-108 represents an alternate upward path from the Apple II. Some dealers report that there are customers who are trading their Apple II computers for the Basis-108. Several users have said that this is what the Apple II’s successor should have been.

The Basis 64K unit with no drives, but with a cable set and game paddles, sells for $2050, not a bad price if you add up all the equivalent options being supplied. The 128K Basis costs $2350. A 64K Apple computer with one drive and 35 tracks costs $2625, with two drives, $3100. A 128K Basis-108 with two drives “lists” for $3400. These prices do not include the video display, which will add from $150 to $995, depending on selection. These are suggested prices from Basis Inc. Selling prices in the stores will vary a great deal, of course. In any event, the Basis-108 is a good-quality product, has exceptional versatility, and, expectedly, does not come cheap. Having a 6502 CPU with Apple compatibility down to the card slots plus a Z80 CPU with CP/M certainly offers a world of computing opportunities in a single system.

**IBM-PC Clones**

The IBM Personal Computer has now been on the market for one year and has become one of the best-selling machines in the industry. IBM has limited the number and location of computer stores and dealers selling its machine thus far. It is likely that the IBM PC compatible market will become a large part of the microcomputer business, with many companies building boards to plug into the IBM-PC and writing software to run on these machines. Some companies are also building functional clones of the IBM-PC Computer. It is difficult to define just what an IBM-PC clone is because this computer does not come with bundled software. IBM offers a choice of operating systems, all of them being written by other companies. The most popular DOS has been PC/OS, also known as MDOS or SB86 DOS. Running second and third are Digital Research CP/M/86 and the UCSD-P System. Phase One Oasis 16 is also being offered for the PC.

We cannot define every computer with an 8088 CPU that runs the same software as the IBM-PC as a clone, anymore than all the different machines that run CP/M are clones. We will therefore define an IBM-PC clone as a computer that uses either an 8088 or an 8086 CPU, runs the same software, and uses the same plug-in circuit boards as the IBM PC. There are several of these either in production or about to go into production.

**The Hyperion Computer.** From Dynalogic Info-tech of Ottawa, Canada, this is a 20-lb portable computer with a 7” amber screen, two 5½” disk drives, a detached keyboard compatible with the IBM PC keyboard, and 256K of RAM. The Hyperion is one of the outstanding designs in portable computers as well as a very powerful computer.

The CPU is the 8088 16-bit processor and there is provision for the 8087 floating-point processor. The 256K user RAM is equipped with parity checking and there is also a 20K video RAM and an 8K ROM containing diagnostics and the monitor program. The display has 25 lines of 80 characters with five pages of display data. The character set has 256 characters, includ-
ing Greek, foreign language special characters, and mathematical symbols. The graphics display format is 640 dots wide by 250 (or 200) dots high, fully addressable array; or 320 dots wide by 250 (or 200) dots high, with 4-level gray scale. The I/O includes the RS-232C standard with an asynchronous 75-to-19.2K baud rate or synchronous 100K with bismick and bit-oriented protocols. The parallel port is compatible with IBM/Epson or Centronics printers.

The Hyperion series also includes a built-in 300-baud modem with auto answer capabilities. The CRT and the disk drives automatically shut down when not in use to conserve energy and prolong life. Other features include a time and date clock with battery back-up, a programmable sound system, and an optional expansion chassis with a 10M-byte Winchester cartridge drive and four IBM-compatible I/O slots. The keyboard fits into an opening at the bottom of the computer and the whole thing fits into a vinyl traveling case.

The software for the Hyperion includes MS DOS, Microsoft Advanced Disk BASIC, Microsoft Multiplan electronic spreadsheet, an Executive text editor and electronic mail system, a telephone management system, and optional languages including Pascal, COBOL, FORTRAN, and a BASIC compiler.

The Hyperion contains everything one could possibly want in a small computer, with the added advantage of being portable. The only drawback is the price; the Hyperion costs $5000. This is not high if all the features provided are considered; but since the equipped IBM-PC costs about $1000 less, it will appeal only to those who need IBM compatibility in a portable machine.

The Eagle Computer. The BC1600 series of computers made by Eagle uses the Intel 8086 16-bit microprocessor and is compatible with the IBM PC. The single-user Model 1610, offers 128K of user RAM and an 8088 CPU running at 8 MHz. It has two built-in disk drives with a total of 1.6M bytes, formatted. The Eagle is built into an integrated cabinet which contains the central processing unit, 12" video monitor, full keyboard with 95 keys including 14 with user-designated functions, and the disk system. All I/O connectors are on the rear panel and they include both RS-232C serial and Centronics compatible parallel ports. The Eagle BC1600 series also has provisions for adding up to seven IBM-compatible plug-in boards. Color graphics is also available as an option. The single-user BC1610 runs MS-DOS or CPM-86 as an operating system. Oasis-16, Xenix and IRMX-86 operating systems are also available as options.

The Model 1630 offers 512K bytes of user RAM with integral floppy and hard disks for a total storage capacity of 10M bytes. The Model 1630 also contains asynchronous serial ports to support up to eight local or remote terminals. The Eagle Model BC1630 is the only IBM-PC compatible unit we have seen that is equipped for multi-user operation.

The single-user Model 1610 will sell for around $5000 complete except for software, while the multi-user Model 1630 will sell for about $9000. At the time of writing this article, the final prices had not yet been set.

We did not have a chance to test the Eagle BC1600 series since only the prototypes had been completed in time for the Comdex show in Atlantic City. We did have a chance to operate the Model 1610 at Comdex. In all, we found it to be as promoted. The Model 1630 as a multi-user IBM-PC clone will appeal to businesses with distributed workstation requirements.

The Columbia 8088 Multi-Personal Computer. Columbia Data Products has introduced a computer that seems to be a clone of the IBM-PC in appearance as well as function. The Model 1600-1 is an 8088-based computer with 128K of RAM, two RS-232C serial ports, a Centronics-compatible parallel port, and dual floppy disks with 640K bytes of storage. The computer has a detached keyboard and slots for up to eight IBM-PC-compatible plug-in boards. The Model 1600-1 has a suggested price of $2995, a low price considering the features offered. The Winchester technology hard disk models, 1600-2 and 1600-3 are equipped with a 320K floppy disk and either a 5M- or 10M-byte hard disk. These units feature a cache-buffer hard-disk controller with an independent 64K processor system that provides enhanced disk access performance in both single- and multi-user configurations. The 1600-2 has a suggested price of $4995 and the 1600-3 has a suggested price of $5495. These computers were displayed at the Comdex Show, but were not available for test at the time this article was written. They appear to take the concept of the IBM-PC one step beyond the single-user computer.

Conclusions

There seems to come a time in the development of every branch of the electronic industry when a leader is established and all the other manufacturers devote their efforts to copying the leader. After that the public has a choice between tweedledee and tweedledum. This seems to be happening in the personal computer industry, especially in the portion of it that is concerned with making desktop units.

Until now the computer industry has been marked with spurts of great innovation as manufacturers rushed to build machines using the newest microprocessors. With the availability of such advanced microprocessors as the Motorola 68000, the National 16000, and the Z8000, it would indeed be a shame if computer manufacturers simply restricted their output to copies of popular machines. There is some reason to build TRS-80 or Apple II clones if they contain advanced features not found in the originals and also make use of the vast stock of available software. However, we see no reason to build IBM-clone after IBM-clone during a time when volume deliveries of IBM-PC's are just underway and there is no great store of software.
Build the Mailbox Sentry

LED and tone indicators announce mail arrival at remote location

By Les Svoboda

A RURAL mailbox is often located a good distance from the house, which makes it difficult to tell when mail has arrived. The "Mailbox Sentry" helps solve this problem by sounding a tone and lighting a LED in the house when the mailbox door is opened. The tone stops after approximately 20 seconds, but the LED remains on until it is manually cancelled by operating a pushbutton.

Circuit Operation. As shown in the schematic, Fig. 1, a CMOS 4001 chip, IC1, is set up as a dual set-reset latch. Each latch is triggered by the leading edge of a positive-going pulse provided by switch S7 at the mailbox. The pulse remains high as long as the mailbox door is open (switch is closed). During this time a reset is not possible. In fact, if your mailbox is left open, you'll know about it because you won't be able to perform a reset.

When the mailbox is opened, pin 11 of IC1 goes high and turns on transistor Q1. This activates the alarm circuit, which consists of 555 timer IC2 (operating in the astable mode) driving an 8-ohm speaker SPKR1. The alarm times out in about 20 seconds due to the RC time constant of the 10-µF capacitor C1 and 2.2-megohm resistor R8. A normally open pushbutton switch, S3, is placed across the capacitor so the alarm can be prematurely silenced, if desired.

Pin 4 of IC1 also goes high when the mailbox is opened, and turns on

---

**PARTS LIST**

- B1—9-V battery
- C1—10-µF, 25-V electrolytic
- C2,C3—1-10-µF, 25-V electrolytic
- C4—0.001µF, 25-V ceramic disc capacitor
- C5—01-µF, 25-V ceramic disc capacitor
- C6,C7,C8—0.01-µF, 25-V ceramic disc capacitor
- IC1—4001 quad NOR gate
- IC2—555 timer
- LED1—Red or green light-emitting diode
- Q1—2N2222 npn silicon transistor (or similar)
- R1,R2—22 kilohms
- R3—1 kilohm
- R4—4.7 kilohms
- R5—10 kilohms
- R6—47 kilohms
- R7—100 kilohms
- R8—2.2 megohms
- S1—Normally open microswitch, magnetic reed switch, or mercury switch
- S2 through S4—Normally open pushbutton switch, panel mount
- SPKR1—6-ohm, 2" or 2½" speaker
- Misc—14-pin DIP socket, 8-pin DIP socket, battery clip, Veroboard™ or perf board, #8451 Belden audio wire, hookup wire, case, mounting hardware, construction adhesive, etc.
We accept OK 13801.1 013.

ELPAC POWER SUPPLIES - D/C/DC CONVERTERS

First Quality Components - No Mail Order "Seconds"

Stack No. 1251 - Fidgy Dist. Power Supply For $109.00

Special of the Month!

MEMORY SALE!

4116-3 200NS 16K $2.10 ea.
Dynamic Ram Stock No. 47650 $8,155.12
2114-L3 300NS 4K $2.45 ea.
Static Ram Stock No. 47640 $8,177.84
2716 45NS 16K Eeprom $3.90 ea.
Stock No. 47632 Any Quantity

MODUTEC

Mini-Clamp AC Volt-Meter allows simple conductor outlet of many without disarrangement.
Stock No. AC Ammeters Price
13730 $0.24 $0.30
13731 $0.50 $0.50
13732 $1.00 $1.00

ACCESSORY LINE SPLITTER

allows fast readings of AC power consumption of plug in equipment without separation of leads.
Stock No. 13773 $9.95

POCKET SIZE BATTERY TESTER

for all types of small batteries from 3½v to 4½v.
Stock No. 13778 $13.95

VOLT-I-CATOR

automotive diagnostic meter plugs into cigarette socket and indicates battery condition and charging rates.
Stock No. 13776 $15.95

AC VOLTAGE TESTER

plugs into any 110v service receptacle to check time voltage over 50-150 VAC.
Stock No. 13775 $14.95

OK MACHINE AND TOOL

IC EXTRACTOR

One-piece, spring steel construction will extract allLSI MSI and SSL devices with 8 to 24 pins.
Stock No. 13313

$1.00 ea pack of 25

Fig. 2. Cement the wire into a groove in the sidewalk using some sort of construction adhesive.

A shielded cable such as Belden’s #8451 shielded audio pair is run from the switch to the house. This type of wire was chosen because it has a heavy and durable plastic covering that will last a long time buried underground. It is also of a fairly small diameter so that it fits nicely within the breakaway grooves of a sidewalk. With a caulking gun, place a bead of construction adhesive such as Liquid Nails (trademark of Maaco Adhesives—SCM Corp.) within the groove, imbedding the wire into the bead. Place another bead over the wire and smooth it with your finger. This makes a permanent installation below the surface of the sidewalk in a few minutes (Fig. 2).

The rest of the cable is then conveniently routed into and through the house, and connected to the “Mailbox Sentry” unit. The shield can be connected to a convenient ground if desired. The unit should be mounted where it can be easily seen or heard, and where it can be reset after the mail is picked up.

Construction. The circuit is simple enough to be constructed on Veroboard® or perf board. DIP sockets are recommended for the ICs.

After the unit’s case has been drilled for switch openings and sound emission, the speaker can be mounted on the inside front of the case using a few dabs of silicon sealant.

Installation. A microswitch is mounted under the mailbox where it can close when the door is opened, and open again when the door is closed. (A magnetic Reed switch or mercury switch can be used if desired.)

ELPAC POWER SUPPLIES - SOLV SERIES FULLY REGULATED

OK MACHINE AND TOOL

IC INSERTION/EXTRACTION KIT

IC sockets that have been recommended for the ICs.

It is possible to drill a hole in the mailbox and mount the unit within. This makes it possible to have a pushbutton switch mounted on the front of the house. The shield can be connected to a convenient ground if desired. The unit should be mounted where it can be easily seen or heard, and where it can be reset after the mail is picked up.

Construction. The circuit is simple enough to be constructed on Veroboard® or perf board. DIP sockets are recommended for the ICs.

After the unit’s case has been drilled for switch openings and sound emission, the speaker can be mounted on the inside front of the case using a few dabs of silicon sealant.

Installation. A microswitch is mounted under the mailbox where it can close when the door is opened, and open again when the door is closed. (A magnetic Reed switch or mercury switch can be used if desired.)

A shielded cable such as Belden’s #8451 shielded audio pair is run from the switch to the house. This type of wire was chosen because it has a heavy and durable plastic covering that will last a long time buried underground. It is also of a fairly small diameter so that it fits nicely within the breakaway grooves of a sidewalk. With a caulking gun, place a bead of construction adhesive such as Liquid Nails (trademark of Maaco Adhesives—SCM Corp.) within the groove, imbedding the wire into the bead. Place another bead over the wire and smooth it with your finger. This makes a permanent installation below the surface of the sidewalk in a few minutes (Fig. 2).

The rest of the cable is then conveniently routed into and through the house, and connected to the “Mailbox Sentry” unit. The shield can be connected to a convenient ground if desired. The unit should be mounted where it can be easily seen or heard, and where it can be reset after the mail is picked up.

Construction. The circuit is simple enough to be constructed on Veroboard® or perf board. DIP sockets are recommended for the ICs.

After the unit’s case has been drilled for switch openings and sound emission, the speaker can be mounted on the inside front of the case using a few dabs of silicon sealant.

Installation. A microswitch is mounted under the mailbox where it can close when the door is opened, and open again when the door is closed. (A magnetic Reed switch or mercury switch can be used if desired.)

A shielded cable such as Belden’s #8451 shielded audio pair is run from the switch to the house. This type of wire was chosen because it has a heavy and durable plastic covering that will last a long time buried underground. It is also of a fairly small diameter so that it fits nicely within the breakaway grooves of a sidewalk. With a caulking gun, place a bead of construction adhesive such as Liquid Nails (trademark of Maaco Adhesives—SCM Corp.) within the groove, imbedding the wire into the bead. Place another bead over the wire and smooth it with your finger. This makes a permanent installation below the surface of the sidewalk in a few minutes (Fig. 2).

The rest of the cable is then conveniently routed into and through the house, and connected to the “Mailbox Sentry” unit. The shield can be connected to a convenient ground if desired. The unit should be mounted where it can be easily seen or heard, and where it can be reset after the mail is picked up.
Printing Computer Graphics

Dot-matrix printers with bit-image graphics provide exciting hard-copy illustration opportunities for small-computer owners

By Stan Veit  
Technical Editor

Creating computerized illustrations and other images on a video screen and reproducing them on a printer has become an important application of personal computers. All that is required to enjoy this function is a computer with a memory-mapped video system, a dot-matrix printer with bit-image capability, and a suitable graphics print program.

Virtually any personal computer with self-generated video can be used to "draw" pictures on a screen. With some machines, this might be done by putting a computer's graphic characters on a screen in sequence to form the desired images. Other computers utilize bit-mapped graphics, where the screen is assumed to be a matrix of dots turned on or off to form images.

With the advent of the low-cost dot-matrix printer, it has become possible to directly print dot graphics from the data stream of the computer. It is quite simple to print the graphic characters providing the printer includes them in its internal character set. However, doing a "screen dump" of a complex video graphic program is another matter. The printer must be built so that the user can control the printing of each dot and the spacing of the print image. It must be possible to turn off the standard character set while the print logic takes its orders from the program being executed. Most of the dot matrix printers that have this capability are listed by manufacturer in Table I.

Bit-Image Graphics. All of the dot-matrix printers with bit-image capability work the same way. The printer head consists of a series of wires. As the paper head is moved across the line, the printed dots form characters or graphic images. At the end of the print line, the printer head is returned to character position 1, and the next line is printed in the same way. This is unidirectional printing. In other printers, logic is included to permit printing in either direction—bidirectional printing.

Figure 1 shows how the print wires form a printed character. Normally, the computer sends the printer the code for a character. The printer has a ROM memory chip called a character generator and the program in this memory sets the wire firing pattern for each character in the set. A printer that has provisions for bit-image graphics recognizes a certain code sent by the computer as an instruction to turn off the character generator and bypass the print logic that controls the firing order of the wires. Then, the printer interprets the data stream following the turn-off code as direct orders to fire certain wires. This control permits the printing of a pattern of dots on the paper to form a graphic image. In some printers, the dot printing is done through a multi-colored ribbon and the result is the same as color printing. The shading and color resolution is the result of the closeness of the printed color dots. Some printers have only the capacity to print graphic images in one
...GRAPHICS

density; others can print more than one density to give much higher resolution.

As an example of what a printer can do with bit-image graphics, we will consider the Epson printer. Some of this information was obtained from manuals published by Epson America and from a paper, “Bit Image Graphics On The Epson Printers” by Robert Diaz, Applications Engineer.

The Epson MX-70 Printer can print graphics in the normal graphics mode only. The MX-80 series of printers require the Graftrax option in order to print graphics in normal or dual-density modes. The MX-100, with a built-in Graftrax option, can print graphics in both modes.

On the Epson printers, the graphics mode is entered by sending the printer an ESCAPE code followed by the character “K,” and two hexadecimal numbers each consisting of two digits (n1, n2) to define the amount of bit-image data to be transferred. The n1 represents the low-order two bits, and n2 the high-order two bits. In the MX-100, the maximum line width is equal to 816 dot positions in the normal-density mode and 1632 dot positions in the dual-density mode. Any values of n1 and n2 over 816 in the normal-density mode are ignored and the graphic image represented by that number will not be printed. After printing the maximum number of dot positions in the line, the printer automatically returns to the text mode to print the next line. If another line of graphics is to be printed, it must start with ESCAPE K once again. The code for the dual-density mode is ESCAPE L instead of ESCAPE K.

When BASIC is being used to control the printer, the values for n1 and n2 are obtained by using the BASIC function CHRS( ). This should allow the computer to send any number to the printer. However, in the real world many computers use certain numbers not available to the operator.

Look at the bit image program in Table II. On some computers, this program may not function correctly due to software limits imposed by the BASIC operating system. Otherwise, when the program has been entered and run properly the pattern in Fig. 2 will be printed. Since the program listed the characters “ABCDEFGH” for printing, where did the pattern come from?

In the program, CHRS(27) is the ASCII code for ESCAPE. The letter “K” sets the printer into the normal-density mode. CHRS(8) is n1, CHRS(0) is n2. The total number of bytes is n1 + (n2*256) or 8 + (256*0) = 8. If n2 had equaled 1, then 8 + (256*1) = 264 and the printer would have been programmed to receive 264 characters. In Fig. 2, however, the printer was programmed to receive 8 characters.

When the computer sends a character to the printer, it is sent in binary form. The printer then converts it into a predefined form as described in its character generator ROM. The ASCII code defines each binary number up to the value 127 decimal and each of these numbers has a predefined function or printable symbol. This standard is followed by most computer and peripheral manufacturers.

When it is in the bit graphics mode, the printer does not print the letters sent to the printer; rather, it prints a pattern of dots equivalent to the binary value of the ASCII code of the letter sent to the printer. The letter “A”, for example, is 65 decimal, 01000001 (binary, base 2). Compare the printed image in Figure 2 with Table III.

Now compare Table III to the relationship between the input data and the dot wires in Fig. 3. Where the data contains a “1,” a dot will be printed. The TRS-80 Mod I will not run the sample program correctly because it cannot send a decimal 0 as shown in line 20 CHRS(0).

Also the TRS-80 Mod I cannot send decimal 10 or 12 from the BASIC function.

The TRS-80 Mod III cannot send decimal 10 or 12 from the ONE function.
You might want to try the following changes:

100 FOR X2 = 0 TO 255: REM X2 = 0 WITH THE APPLE OR TRS COLOR COMPUTER
150 X = X2: GOSUB 10
175 NEXT X2

This prints out all possible combinations of graphics characters. When the program has been run, a clear pattern will appear. Refer to Table VI.

If you want to print a shape, it must be broken up into numbers as shown in Fig. 4. A box is drawn on a sheet of graph paper, with the rows numbered the same as the pins and columns numbered according to how many you need. In Fig. 4, the total number for column 1 is 64 + 32 + 16 + 8 + 4 + 2 = 126. Columns 2 through 6 add up to 66 and column 7 is the same as column 1. Thus the data for the program to draw the figures is 126, 66, 66, 66, 66, 66, 126. Now add the subroutine for your computer to the program in Table VII.

When this program is run, it will print a rectangle. By changing line 180 to 8, 8, 8, 8, 20, 34, 65, you can change the shape printed to look like the one in Figure 5.

Line 105 of the program in Table VII sends the ESC K. Line 110 sends n1 and line 120 sends n2. For

---TABLE II—BIT-IMAGE PROGRAM---

<table>
<thead>
<tr>
<th>Value</th>
<th>Bit A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>128</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>64</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>32</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

---TABLE III—ASCII CODE---

| TRS-80 Mod I | 10 IF PEEK(14312) > 63 THEN GOTO 10: REM WAIT FOR PRINTER TO BE READY
| TRS-80 Mod III | 20 POKE 14312,X: REM SEND THE VALUE X TO THE PRINTER
| Atari | 30 IF PEEK(14312) < 63 THEN GOTO 30: REM SAME AS LINE 10

---TABLE IV—SUBROUTINES---

80 PRINT CHR$(27); "K"; CHR$(8); CHR$(0); "ABCDFGHH"; "TESTING;"
30 NEXT I
40 END

---Fig. 4. Converting a shape to numbers---

---Fig. 5. Changing numbers changes shape---

---American Radio History (1982)---
...GRAPHICS

...beginners, it is best to use a range of 1 to 255 for n1 (on an Apple use 1 to 127) and set n2 to 0. A beginner is less likely to have problems, or crash his program if shorter lengths are used.

While printing bit-image graphics, a single number controls 8 rows in one column. This type of printing is useful for simple jobs like defining your own character set, but is somewhat limited for doing drawings on a printout. The solution to this problem is to print the image in multiple passes. Thus, if you were printing the drawing in three sections, you would print the top first, then the middle, and then the bottom. However, the printer is designed to leave spaces between passes (rows). One additional command must be given to change the line feed spacing so there are no gaps between the passes. This command in BASIC is:

```
PRINT CHR$(27); "A"; CHR$(7);: REM FOR APPLE AND COLOR COMPUTERS
PRINT CHR$(27); "A"; CHR$(8);: REM ALL OTHERS
```

Once you are done printing graphics, you must restore the printer to the original line spacing with the command:

```
PRINT CHR$(27); "A"; CHR$(12); OR PRINT CHR$(27); "2";
```

Some systems add a carriage return/line feed after 80, 127, 132, 255, or 256 characters have been printed. If your system does this, you will find that a small gap appears in your graphics printout. Should that occur, either limit the length of your drawings or bypass the operating system in your computer.

Once the printer has been programmed to receive a number of graphics characters, sending it too few will make it appear as if the printer did not receive them. When the program is re-run several times, the printer may start to print subsequent drawings on the same line. Sending more characters than the printer was programmed for may put “garbage” at the end of the line. Watch out for a condition in which your BASIC is adding or removing any data.

When printing long lines above 240 characters (80 on the Epson MX 70), BASIC slow-speed will cause the printer buffer to fill, then stop, and print the first part of the line. Next the program will continue, home the print head, and print the rest of the line. This is a normal procedure.

Only experience and patience can help you in the execution of complex graphic images. The printing of graphic pictures requires precise layout using graph paper and pencil before any programming is done.

The use of the new Prism printers from Integral Data Systems requires the additional element of commands to control the position of the multi-color ribbon. It not only requires that the printhead print the graphic image, but that the printing be done in the desired color.

**Graphic Print Software.** In order to print a graphic image, you can start with a picture, design, or character and lay it out on graph paper. You can then convert the black, white or grey areas into program statements that will activate the dot matrix wires in the print head and print the picture as a type of half tone.

Very few people go to this kind of trouble anymore. There are much simpler methods to print computer graphics.

Artists can compose a drawing and put it into a computer with the aid of a graphics program. They utilize either a light pen or graphics tablet to convert the artwork into digital form. In this way it becomes a high-resolution, screen video program and it can be viewed and corrected before printing. The screen image can then be “dumped” to a graphics printer and reproduced on paper. It is a good idea to use a color or graphics program to compose the image and then to look at it on a black and white monitor. In this way the gradations of the image will exist and can be seen as tones of grey.

Because the Apple II was one of the first personal computers to have color graphics capability, the largest body of graphics printing pro-

---

**TABLE V—GRAPHICS PROGRAM (TWO PARALLEL LINES)**

| 5 GOTO 100 |
|---|---|
| 10 YOUR SYSTEM'S SUBROUTINE |

| 100 REM GRAPHICS PROGRAM |
|---|---|
| 105 PRINT CHR$(27); "K";: REM SENDS ESC FOLLOWED BY A K |
| 110 LET X = 60; GOSUB 10; REM SEND n1 |
| 120 LET X = 0; GOSUB 10; REM SEND n2 |
| 130 REM n1 + (256*n2) = TOTAL NUMBER OF GRAPHICS CHARACTERS THE PRINTER WILL BE PRINTING |
| 140 FOR I = 1 TO 60 |
| 150 LET X = 65; GOSUB 10 |
| 160 NEXT I |
| 170 PRINT " X = "; X |
| 180 END |

**TABLE VI—PINS AND VALUES**

<table>
<thead>
<tr>
<th>Top Pin</th>
<th>Pin No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>128</td>
<td>64</td>
</tr>
<tr>
<td>32</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>not used</td>
</tr>
</tbody>
</table>

If X = 0, no pins will fire
If X = 1, pin 1 will fire
If X = 2, pin 2 will fire
If X = 3, pins 1 and 2 will fire
If X = 4, pin 4 will fire
If X = 5, pins 1 and 4 will fire
If X = 65, pins 64 and 1 will fire
To get all 9 pins to fire, X = 255

**TABLE VII—GRAPHICS PROGRAM (RECTANGLE)**

| 5 GOTO 100 |
|---|---|
| 10 YOUR SUBROUTINE |

| 40 RETURN |
|---|---|
| 100 REM PRINT A SHAPE |
| 105 PRINT CHR$(27); "K"; |
| 110 X = 7; GOSUB 10 |
| 120 X = 0; GOSUB 10 |
| 130 FOR I = 1 TO 7 |
| 140 READ X |
| 150 GOSUB 10 |
| 160 NEXT I |
| 170 PRINT |
| 180 DATA 126,66,66,66,66,126,126 |
| 190 END |

---

AmericanRadioHistory.Com

Computers & Electronics
programs exist for that computer. We will mainly discuss Apple II software, although we will describe graphics printing programs for other computers. They all operate in a similar manner; either they link to a screen graphics program or they permit the user to load the screen graphics file directly into the program. These graphics printing programs offer optional selection of program parameters in order to accommodate various interface boards and printer characteristics. Some offer the option of size changes and aspect rotation. When the program is run, it figures out the correct numbers to send to the printer mechanism to print the correct pattern of dots in the right position to form a graphic image.

Before going into discussing graphics printing programs on the market, we must point out that there are many such programs in the public domain. It is well worth the time spent to research the catalogs of the various User-Groups and the indices of magazines which print utility software for your computer and operating system.

Computer Stations, 11610 Page Service Drive, St. Louis, MO 63141 was one of the first publishers of Apple graphics software and it has an extensive line of graphics printing programs.

"Combined Enhanced Graphics Software," by David K. Hudson, covers the broadest possible range of Apple II parallel interface cards and printers. When the diskette is booted, a menu asks for the printer being used, the type of interface card and the card slot number. A diskette can be customized to always have these parameters if so desired.

The next menu asks for a user selection of options including page size, image type (plot or picture), justification, catalog (of disk in drive), display graphics (on screen), print graphics, and new page (form feed). Before you can print a graphic image, it must be loaded into the high-resolution page (an area of memory reserved by the Apple II for displaying graphics). There are two hi-res pages in memory. There are many methods of doing this: 1) Use graphics or a plot program to generate the graphics file. 2) Load the hi-res area by drawing the image using a graphics tablet and saving the result in the memory. 3) Use a video digitizer to scan the image and use an a/d converter to load the result into memory.

Computer Stations makes a video digitizer called Ditherizer II which uses a video camera to load the hi-res page into memory. It saves it as a binary file which can be printed by Enhanced Graphics Software. We have used this program and it works very well. Computer Stations also has #8502 Combined Graphic Writer for Applesoft 3.3 and a large selection of printers and interfaces, including the latest IDS Prism color printers and the Epson 100.

The Ultra High-Res Graphics program for the Epson MX-80 and MX-100 by Mark Allen and David Hudson is a plotting utility program that will produce output as large as a full page of printer output. This is a very useful type of graphics program. All Computer Stations programs are self-teaching and easy to use.

"Image Printer" by Jerry Rivers is published by Sensible Software, 6619 Perham Dr., West Bloomfield, MI 48033 for Apple II with 48K and Applesoft or Epson MX70, MX-80 or MX-100 with Grafix. This hi-res graphics program also comes in versions for daisy-wheel printers and for the C. Itoh "Prowriter" and the NEC 83023.

When booted, it presents a menu that permits printing from a picture in memory or from a picture stored on a disk, or to print the inverse of picture now in memory. It also configures the printer card set-up, views the picture in memory, or sets the picture parameters. There is an option to reduce the picture by 1/4. There is no rotate option which is found in most other graphic print programs. In spite of the fact that the MX-100 Printer is listed, it would not center the picture on the 14-inch paper. It seems to be written for 8-inch printers. Although Image Printer works, it is full of little annoying things that should not exist in commercial software.

"Graphtrix" from Data Transforms, 906 East Fifth Ave., Denver, CO 80218, at $65.00, is not only a graphic image printing package, but it also permits the inclusion of footnotes, superscripts and graphics in documents written in Apple Writer, word processor, or Data Transform's editor called Editrix. It can be used with the Apple II+, 48K and a wide range of printers and printer interface boards. It comes on a bootable disk and includes a "hand-holding screen dump" which is an instructional discussion of how to use the program to print a high-resolution page on the printer. The program shows the picture on the screen exactly as it will be seen as a printed copy. This is the reverse of the display of most other programs. There is also a GTRX DUMP that is a separate utility that you can call from an Applesoft program. It includes all of the same parameters of the main program.

If Apple Writer is your word-processing program, then you can specify the Graphtrix parameter as text formatting commands within the files. A conversion program is used to change the Apple Writer file to one that Graphtrix can use. Then another routine is used to print the picture data file. You then specify the printer and the slot parameters. When the printing starts, it prints both the text and the picture in the correct position. This is Graphtrix's outstanding characteristic. To see the text, illustration, footnotes and superscripts printed in proper layout form is an amazing demonstration of the Graphtrix program capabilities. Although this system costs almost twice as much as some other graphic printing packages, it does offer greater utility.

"Zoom Grafix" by Dave Holle, published by Phoenix Software Inc., 64 Lake Zurich Dr., Lake Zurich, IL 60047, costs only $39.95 and is one of the better graphic printing programs for the Apple II. This package offers over 400 combinations of I/O boards and printers. It is similar to the other programs discussed in this article, but
it has some very attractive additional features. The principal new feature is the one that gives this package its name. The user has the ability to focus in on a detail of a picture and to enlarge it through a broad range of magnification just like a zoom lens on a camera. It also permits completely controlled cropping. The user can select both the size and proportions of the printed graphic image from over 65,000 combinations. One unique feature of Zoom Grafix is the ability of the user to rotate the graphic image and print the new aspect.

Pictures can be centered automatically, or the margins can be set by the user to place the printed picture exactly where it should be printed. Printing can be either positive, or negative and either upright or rotated.

A number of graphic images from the Apple System master disk are supplied with the Zoom Grafix diskette to give the user something to practice with.

"Printographer" by Stephen L. Ballard is published by Southwestern Data Systems for the Apple II. It costs $49.95 and it is another menu driven graphics print package with desirable features. It includes a selection of every popular printer and I/O board combination on the market. This package will work with the Qume Sprint and NEC Spinwriter daisy-wheel printers as well as the dot matrix printers. Pictures can be printed in normal or reverse, horizontal or vertical position, and they can be magnified up to nine times the original size. The picture can be moved and printed anywhere on the page. The Printographer lets you print either the entire hi-res screen or any portion of it using the cropping features. The Printographer has a subroutine that can be used within your own Applesoft programs so you can print out any hi-res screen in a few seconds. The package comes with the best manual of any of the graphics packages for the Apple II. It is almost a course in printing graphics by itself. Although this package is one of the higher-priced efforts, it is well worth the extra money.

"Super Quality Epson Hi-Res Dump" by Roger Doss, published by Avant Garde Creations, P.O. Box 30160, Eugene, OR 97403 is for the Apple II with 48K and the Epson MX-80 or MX-100 Printers. This $25.00 package enables the user to print hi-res graphic pictures with several unusual options available. The picture is printed without any streaks or grey. The printout will always be true black and white. The user can select mirror images, negative images, flip images, or rotated images. Images can be saved and loaded from disks, while footnotes, titles and superscripts can be added and printed with the pictures.

"The Grappler," Orange Micro, 3150 E. La Palma, Anaheim, CA 92806 is an interface board for the Apple II that works with most of the dot matrix printers with graphic capabilities. It is included in this discussion of graphic printing software because it has graphics printing firmware built-into the board circuits. Since there is no standardization among printer manufacturers for dot graphics, there is a separate version for each printer. The graphics image is drawn with a graphics peripheral and saved as a file by the computer. To print it using the Grappler, the printer is sent a control sequence of CTRL-I followed by G and then one of several optional characters. These sequences will cause the graphic image to be printed at the selected location on the paper. One of the options permits the rotation of the graphic image 90 degrees in a clockwise direction.

Atari Graphics. Graphic image print programs for the Atari computers have been featured in several of the magazines devoted to 6502 software. There are also many of them available through user groups. Commercial programs to print graphics are just starting to appear because up to now very few Atari owners had disk systems. With the growing population of Atari disk-based systems, several software houses have released graphic print packages.

"Color Print" from Datasoft Inc., 19519 Business Center Dr., Northridge, CA sells for $39.95 and works with a 40K Atari Computer. It is menu driven like the Apple II programs and works with the Epson MX-80. The Color Print package is capable of printing black-and-white graphics in 2, 3 or 4 high-resolution colors.

"Atari Screen Dump II" from Computer Age Software, 9433 Georgia Ave., Silver Springs, MD 20910 costs only $26.95 for the cassette version and $29.95 for the disk version. Both versions are designed to be used with the Epson MX-80, or MX-100 printers and support all the features of the printers.

Other Computers. Since the printing of hi-res graphics is a rather new application, there are few commerical packages for computers other than the ones mentioned here. For example, there’s such software for Radio Shack’s TRS-80 Color Computer. However, software for the IBM-PC, the VICTOR, the FORTUNE 16/32 and other machines are being written at this time. "Print-Graph" from Micro-Z Company, P.O. Box 2426, Rolling Hills, CA 90274 is a $79.50 graphics printing package designed for the IBM-PC. It works with the IBM, Epson MX-80 printer and the Graftrax PROMS. It requires the IBM Color Graphics Board and one or two disk drives. This package prints out graphic image from hi-res or med-res graphics screen. It reproduces the color image in tones of black and grey. It can print black on white or reverse.
Over thirty years of down-to-earth experience as a precision parts manufacturer has enabled Star to produce the Gemini series of dot matrix printers—a stellar combination of printer quality, flexibility, and reliability. And for a list price of nearly 25% less than the best selling competitor.

The Gemini 10 has a 10" carriage and the Gemini 15 a 15½" carriage. Plus, the Gemini 15 has the added capability of a bottom paper feed. In both models, Gemini quality means a print speed of 100 cps, high-resolution bit image and block graphics, and extra fast forms feed.

Gemini’s flexibility is embodied in its diverse specialized printing capabilities such as super/sub script, underlining, backspacing, double strike mode and emphasized print mode. Another extraordinary standard feature is a 4k buffer (with an additional 4k on the serial board). That’s twice the memory of leading, comparable printers. And Gemini is compatible with most software packages that support the leading printers.

Gemini reliability is more than just a promise. It’s as concrete as a 180 day warranty (90 days for ribbon and print head), a mean time between failure rate of 5 million lines, a print head life of more than 1 million characters, and a 100% duty cycle that allows the Gemini to print continuously. Plus, prompt, nationwide service is readily available.

So if you’re looking for an incredibly high-quality, low-cost printer that’s out of this world, look to the manufacturer with its feet on the ground—Star and the Gemini 10, Gemini 15 dot matrix printers.
The 68000 CPU

What makes this powerful 16-bit processor tick?

By Hunter Scale*

In 1972, Intel Corporation introduced the first microprocessor—the 4004. It was a primitive 4-bit processor, primarily intended to be a cost-reduction replacement for TTL logic in computer peripherals. From that humble beginning, microprocessors have grown in size (measured in instruction word or data bus width) and processing power. They grew first to 8 bits, as exemplified by the 8080 family, the 6800, 6502, etc. Then it went to 16 bits and the word now is that 32-bit micro machines will make their debut soon.

As the computing power grew, applications began to change. The 8-bit processors became powerful enough to support high-level languages such as BASIC, Pascal, and others; and the personal computer became a reality. The new breed of 16-bit micros is so powerful that it is spawning another new product—the personal workstation. Typical of the new 16-bit processors are the Intel 8086, Zilog Z8000, and the NC68000. The 68000 is second-sourced by a number of companies, including Motorola, Mostek, and Signetics. Some of these are so powerful that they are being used in special applications such as digital signal processing and high-resolution computer graphics. These are areas that, not long ago, were the province of expensive custom bipolar bit-slice machines. To see just what makes these new processors “tick,” let’s look at the 68000.

Architecture. To find out how the 68000 meets the requirement of some of the new applications, we have to examine how it “looks” to a programmer: its registers, instruction set, and other capabilities. These make up what the computer scientist calls the architecture. Things to look for include:

- How many registers does it have and how large are they? The more registers it has and the larger they are the better.
- Are the registers general purpose or special? Special registers are those that require the programmer to spend time and effort to use the right ones at the right time.
- How large is the addressing space? (How much memory can it have?) This is particularly important in view of the massive size of modern programs and where graphics are involved.
- How general is the instruction set and how easy is it to remember?

A small number of powerful instructions is easier to use than a larger number of more primitive ones.
- How fast do the instructions execute? The best instruction set in the world is worthless unless the processor is fast enough for the application. This is particularly important in real-time applications.

The 68000 is called a 16-bit microprocessing unit because the data bus is 16 bits wide. However, all the registers in the chip are 32 bits wide, hence the 16/32 title is sometimes used. By comparison, the 8086 and Z8000 use 16-bit-wide registers. The data registers of the 68000 can handle 8-bit bytes, 16-bit words or 32-bit words.

The programming model of the 68000 is shown in Fig. 1. There are eighteen 32-bit registers in the device, eight data registers (labeled

*Motorola, Inc.

![Fig. 1. Programming model of the 68000 microprocessor.](image-url)
Professional Books That Help You Get Ahead—And Stay Ahead!

Join the ELECTRONICS AND CONTROL ENGINEERS' BOOK CLUB and...

- Keep up with current technology
- Sharpen your professional skills
- Be ready for new career opportunities
- Boost your earning power

Why You should join now!
- **BEST AND NEWEST BOOKS IN YOUR FIELD**—Books are selected from a wide range of publishers by expert editors and consultants to give you continuing access to the best and latest books in your field.
- **BIG SAVINGS**—Build your library and save money too! Savings ranging up to 30% or more off publishers’ list prices—usually 20% to 25%.
- **BONUS BOOKS**—You will immediately begin to participate in our Bonus Book Plan that allows you savings of between 70%—80% off the publishers’ prices of many professional and general interest books!

**MAIL THIS COUPON TODAY**

**McGraw-Hill Book Clubs**
Electronics and Control Engineers' Book Club
P.O. Box 582, Hightstown, N.J. 08520

Write Code No. of the $2.89 selection here
Write Code No. of First Selection here

Please enroll me as a member and send me the two books indicated, billing me for the $2.89 premium and my first selection at the discounted member’s price, plus local tax, shipping and handling charges. I agree to purchase a minimum of two additional books during my first year of membership as outlined under the Club plan described in this ad. A shipping and handling charge is added to all shipments.

Signature __________________________
Name __________________________
Address/Apt. ______________________
City/State/Zip ______________________

This order subject to acceptance by McGraw-Hill. All prices subject to change without notice. Offer good only to new members. Orders from outside the U.S. cannot be accepted.

E33573
...68000

D0-D7), nine address registers (A0-A7 and A7') and one program counter (PC). The status register is 16 bits wide and consists of a user byte and a supervisor byte. Data can be manipulated in bits, bytes (8 bits), words (16 bits), and long words (32 bits).

The memory organization used by the 68000 (Fig. 2) can directly address $2^{24}$ (16,777,216) bytes arranged in a linear sequence. Addresses are always byte addresses. That is, words are located at even byte addresses and can only be referred to at those addresses. Long words must also start at word addresses. A byte can be addressed at an even or odd location and the upper or lower half of the word is used. A word is obtained in one access while it takes two accesses to fetch a long word—the upper half (lower word address) and then the lower half (next word address). The I/O is memory mapped.

### Table I—Instruction Set Summary

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Description</th>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABCD</td>
<td>Add Decimal with Extend</td>
<td>MOVEP</td>
<td>Move Peripheral Data</td>
</tr>
<tr>
<td>ADD</td>
<td>Add</td>
<td>MULS</td>
<td>Signed Multiply</td>
</tr>
<tr>
<td>AND</td>
<td>Logical And</td>
<td>MULU</td>
<td>Unsigned Multiply</td>
</tr>
<tr>
<td>ASL</td>
<td>Arithmetic Shift Left</td>
<td>NBCD</td>
<td>Negate Decimal with Extend</td>
</tr>
<tr>
<td>ASR</td>
<td>Arithmetic Shift Right</td>
<td>NE</td>
<td>Negate</td>
</tr>
<tr>
<td>Bcc</td>
<td>Branch Conditionally</td>
<td>NOT</td>
<td>No Operation</td>
</tr>
<tr>
<td>BCFG</td>
<td>Bit Test and Change</td>
<td>BCR</td>
<td>One's Complement</td>
</tr>
<tr>
<td>BCCLR</td>
<td>Bit Test and Clear</td>
<td>BRA</td>
<td>Logical Or</td>
</tr>
<tr>
<td>BSET</td>
<td>Bit Test and Set</td>
<td>BSR</td>
<td>Reset External Devices</td>
</tr>
<tr>
<td>BTST</td>
<td>Bit Test</td>
<td>BTST</td>
<td>Rotate Left without Extend</td>
</tr>
<tr>
<td>CHK</td>
<td>Check Register Against</td>
<td>CHK</td>
<td>Rotate Right without Extend</td>
</tr>
<tr>
<td>CLR</td>
<td>Clear Operand</td>
<td>CLR</td>
<td>Rotate Left with Extend</td>
</tr>
<tr>
<td>CMP</td>
<td>Compare</td>
<td>CMP</td>
<td>Rotate Right with Extend</td>
</tr>
<tr>
<td>DBcc</td>
<td>Test Condition, Decrement</td>
<td>DBcc</td>
<td>Return from Exception</td>
</tr>
<tr>
<td>DIVS</td>
<td>Signed Divide</td>
<td>DIVS</td>
<td>Return from Subroutine</td>
</tr>
<tr>
<td>DIVU</td>
<td>Unsigned Divide</td>
<td>DIVU</td>
<td>Subtract Decimal with Extend</td>
</tr>
<tr>
<td>EOR</td>
<td>Exclusive Or</td>
<td>EOR</td>
<td>Set Conditional</td>
</tr>
<tr>
<td>EXG</td>
<td>Exchange Registers</td>
<td>EXG</td>
<td>Stop</td>
</tr>
<tr>
<td>EXT</td>
<td>Sign Extend</td>
<td>EXT</td>
<td>Subtract</td>
</tr>
<tr>
<td>JMP</td>
<td>Jump</td>
<td>JMP</td>
<td>Swap Data Register</td>
</tr>
<tr>
<td>JSR</td>
<td>Jump to Subroutine</td>
<td>JSR</td>
<td>Halves</td>
</tr>
<tr>
<td>LEA</td>
<td>Load Effective Address</td>
<td>LEA</td>
<td>Test and Set Operand</td>
</tr>
<tr>
<td>LINK</td>
<td>Link Stack</td>
<td>LINK</td>
<td>Trap</td>
</tr>
<tr>
<td>LSL</td>
<td>Logical Shift Left</td>
<td>LSL</td>
<td>Trap</td>
</tr>
<tr>
<td>LSR</td>
<td>Logical Shift Right</td>
<td>LSR</td>
<td>Trap on Overflow</td>
</tr>
<tr>
<td>MOVE</td>
<td>Move</td>
<td>MOVE</td>
<td>Test</td>
</tr>
<tr>
<td>MOVEM</td>
<td>Move Multiple Registers</td>
<td>MOVEM</td>
<td>Unlink</td>
</tr>
</tbody>
</table>

**Instruction Set.** The instruction set of the 68000 is given in Table I. Note that there are only 56 basic instructions, though many of these have variations. This is in keeping with the philosophy that a small number of instructions is easier for the programmer to remember and, therefore, more desirable, provided the instructions are powerful enough.

The usual instructions are found in the set: arithmetic (including multiply and divide), logic set (AND, OR, EOR, etc.), branches, bit shifts and rotates, and compares. The data movement instruction is MOVE—one of the most powerful in the set. The MOVE instruction can take any of the effective addressing modes for either operand. MOVE can move data from anywhere to anywhere (that is, memory to memory, memory to register, etc.). The power of MOVE will become apparent when the addressing modes are discussed.

In addition to the basic instructions, here are some special-purpose instructions intended specifically to support the code generators of high-level languages such as Pascal. These include the LINK and UNLK (unlink), LEA (load effective address), PEA (push effective address), and CHK (check register against bounds).

LINK implements the high-level language procedure call. As shown in Fig. 3, the old stack frame pointer, A2, is saved by pushing it onto the stack. The new frame pointer is created by placing the stack pointer in A2 and, finally, local variables are allocated on the stack by adding an offset to the stack pointer. A jump subroutine instruction is then used to enter the procedure. The UNLK instruction reverses this process by restoring the stack pointer (de-allocating the local variable space) and pulling the previous frame pointer. Re-entrant programs are very fast and painless to implement with these instructions.

One of the most useful instructions is the decrement and branch on condition code (DBcc). This is a looping primitive that will branch if the condition is not met or the counter has not decremented to $-1$. Thus, it replaces a five-instruction sequence—CMP, Bcc, SUB, CMP, and Bcc. This speeds up the very common loops found in all programs.

**Addressing Modes.** One of the reasons the 68000 can get away with such a small number of instructions is by having a set of very powerful addressing modes that, when combined, result in over
53,000 different instructions. See Table II for addressing modes.

Two of the most commonly used addressing modes are the address register indirect with predecrement and postincrements. In this mode, the contents of an address register point to the operand. The address register is either decremented first and then used (predecrement), or used and then incremented (postincrement). The register is decremented or incremented by the number of bytes in the operand to maintain the pointer with different sizes of data. Using these two addressing modes with the MOVE instruction implements the POP and PUSH instructions that are used with push-down, pop-up stacks. For example, MOVE.B D0,−(A7) will "push" the lower byte (.B) of D0 onto the system stack. The advantage here is that each of the eight address registers can be used as stack pointers. Since stacks are used extensively by compilers, this is a handy thing to have.

The 68000 has 14 different addressing modes that can be broken into six basic types. These are: (1) Direct Register Addressing, which consists of data register direct and address register direct; (2) Direct Memory Addressing, formed by absolute short and absolute long; (3) Indirect Memory Addressing, consisting of memory indirect, post-increment register indirect, pre-decrement register indirect, register indirect with displacement, and register indirect with index and displacement; (4) Implied Register Addressing; (5) Program Counter Relative Addressing, containing PC-relative with displacement, and PC-relative with index and displacement; and (6) Immediate Data Addressing, formed from immediate, and quick immediate. This broad range of addressing help creates a powerful instruction set.

System Protection Features.

Since the 68000 was designed to be used in applications that require a mini-computer, much attention was paid to making it a "secure" processor for multi-user environments. For instance, any op codes not implemented on the 68000 get trapped in an illegal op code handler routine. There is also provision for protecting the system against untrustworthy programs via user-supervisor separation.

The processor can be in one of two modes—User or Supervisor. Certain "privileged" instructions can only be executed in the Supervisor mode. The Supervisor and User modes have separate stack pointers. Thus, in program-sensitive applications, system software, executed in the Supervisor mode, can be separated from application programs executed in the User mode. The Supervisor mode is equivalent to the System mode of the Z8000, while the User mode is equivalent to the Normal mode of the Z8000. The 8086 offers no similar operating modes.

In the User mode, the machine cannot execute "privileged" instructions, and any attempt to execute them while the processor is in the User mode will result in privilege trap to the Supervisor mode, removing control from the user program. These control instructions include some special hardware-support instructions, such as RESET, which allows the processor to reset peripheral devices. This provides a certain amount of control over the user programs. In the Supervisor mode, the entire instruction set can be executed, including the privileged ones. In this way, the operating system has complete control over user programs and system resources. Privileged instructions are shown in Table III.

Instruction Execution Speed.

An extensive register set and rich instruction set are only part of what makes a powerful processor. The instructions must also be fast enough to do justice to the rest of the architecture. One rule of thumb used is "bus bandwidth utilization," which is simply how much of the time the processor is fetching instructions or data via the bus. The higher the percentage of time spent using the data bus, the better a job the processor is doing in using that bus. The 68000 uses about 85% of the bus bandwidth for a typical instruction mix. This means that this data processor is fast enough to use almost all of the speed that memory will allow.

### Table II—Summary of Addressing Modes

<table>
<thead>
<tr>
<th>Addressing Mode</th>
<th>Syntax</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data register direct</td>
<td>Dx</td>
<td>ADD.L D0,D1</td>
</tr>
<tr>
<td>Address register direct</td>
<td>Ax</td>
<td>MOVE.L A0,A1</td>
</tr>
<tr>
<td>Address register indirect</td>
<td>(Ax)</td>
<td>MOVE.L D0,(A0)</td>
</tr>
<tr>
<td>Address register indirect with</td>
<td>(Ax)+</td>
<td>SUB.L (A0)+,D0</td>
</tr>
<tr>
<td>postincrement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address register indirect with</td>
<td>−(Ax)</td>
<td>MOVE.L D0,−(A0)</td>
</tr>
<tr>
<td>predecrement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address register indirect with</td>
<td>d(Ax)</td>
<td>MOVE.L 8(A0),D0</td>
</tr>
<tr>
<td>displacement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address register indirect with</td>
<td>d(Ax,Ri)</td>
<td>MOVE.L 8(A0,D0),D1</td>
</tr>
<tr>
<td>index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute short</td>
<td>XXX,W</td>
<td>BRA $400</td>
</tr>
<tr>
<td>Absolute long</td>
<td>XXX.L</td>
<td>BRA $FF0020</td>
</tr>
<tr>
<td>Program counter with</td>
<td>d(PC)</td>
<td>MOVE.L</td>
</tr>
<tr>
<td>displacement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program counter with index</td>
<td>(PC,Ri)</td>
<td>T(02),TABLE</td>
</tr>
<tr>
<td>Immediate</td>
<td>#XXX</td>
<td>MOVE # 100,D0</td>
</tr>
</tbody>
</table>

...68000
The execution time of instructions depends on many things—the processor clock frequency, memory speed, addressing mode used, and the length of the data to be used. Currently, the standard speed, 10 MHz. Assuming that the processor can access memory without wait states (without having to wait for the memory to respond) and that the clock is 10 MHz, some typical instruction execution times would be as given in Table IV.

**Bus Structure.** Now that we have seen how the 68000 looks from the inside, we need to look at it from the outside. A pinout is shown in Fig. 4. The processor is housed in a 64-pin dual-in-line pack and requires a single 5-V power supply.

The bidirectional data bus is 16 bits wide and is nonmultiplexed. The address bus is 24 bits wide, allowing the processor to directly access 2\(^{24}\) or 16 megabytes of memory. Note that A0, the least significant bit of the address bus is not output. This bit is used internally in conjunction with the data size specification of each instruction to generate the UDS and LDS signals. The bus is asynchronous; that is, it is not synchronized to a clock. Instead, it uses a handshake method of bus access. The address strobe signal (AS) indicates the beginning of a memory access and the data transfer acknowledge (DTACK) signal is returned by the memory board to signal the end of the data transfer. A timing diagram of a byte read cycle is shown in Fig. 5.

At time (1), the address is placed on address lines (A1-A23) and the read/write (r/w) line is set to show a read of memory. At time (2), the address strobe (AS) signal is asserted to indicate the beginning of a bus cycle, and the lower data strobe (LDS) signal is asserted to show that the read is on the lower eight bits of the data bus. The memory responds by placing the data to be read on the lower eight data lines (D0-D7) as shown at time (3), and then asserts the DTACK signal to show that the data is available. The processor then latches the data into the chip and negates the AS to show that the cycle is over as shown at time (4). The advantage of this scheme is that it allows the use of different speed memory boards to be intermixed on the bus. Thus the processor can accommodate a wider range...
of memories and peripherals, which may be quite far from the processor itself.

Some signals are provided to allow interfacing to synchronous 6800 peripheral devices. These include: enable (e) which is the standard enable signal for 6800-type devices, valid peripheral address (VPA) input that indicates that the device or region addressed is a 6800 family device and that data transfer should be synchronized with the enable signal. Valid memory address (VMA) output is used to indicate to 6800 peripheral devices that there is a valid address on the address bus and the processor is synchronized to enable. This signal only responds to a valid peripheral address (VPA) input which indicates that the peripheral is a 6800-family device.

**Interrupts.** To support real-time applications, some means must be provided to interrupt the processing of the normal instruction stream to take care of some urgent event. This is called the interrupt. For instance, a printer might want to signal the processor that it has printed a line of text and needs more data. The printer peripheral controller would then transmit a signal to request an interrupt.

The 68000 has seven levels of interrupt priority. The levels that it will recognize are set by the interrupt priority mask in the supervisor byte of the status register. The latter can be programmed to allow the recognition of any level and those above it. The interrupts themselves are signaled by setting the encoded level of the interrupt being requested on the interrupt priority request lines (IPLe-IPLs). The processor will then stop the execution of the current program and read the interrupt vector from the data bus in an operation called “interrupt acknowledge cycle.” The peripheral device which requested the interrupt places the vector number on the data bus. This number will be used as a pointer into a memory location at which an address is to be found. The processor will read this address and start executing the routine contained there. To return to the execution of the interrupted program, a return from exception (RTE) instruction is executed.

**Conclusion.** Sixteen-bit processors are being used in greater numbers in low-cost products because they can accommodate more functions and have faster operation than conventional 8-bit processors. Since they can directly address 16 megabytes of memory, very extensive programming can be used without having to wait for disk ac-

---

**TABLE III—PRIVILEGED INSTRUCTIONS**

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESET</td>
<td>Reset external devices</td>
</tr>
<tr>
<td>RTE</td>
<td>Return from exception</td>
</tr>
<tr>
<td>STOP</td>
<td>Stop program execution</td>
</tr>
<tr>
<td>ORI to SR</td>
<td>Logical OR to status register</td>
</tr>
<tr>
<td>MOVE USP</td>
<td>Move user stack pointer</td>
</tr>
<tr>
<td>ANDI to SR</td>
<td>Logical AND to status register</td>
</tr>
<tr>
<td>EORI to SR</td>
<td>Logical EOR to status register</td>
</tr>
<tr>
<td>MOVE EA to SR</td>
<td>Load new status register</td>
</tr>
</tbody>
</table>

---

**TABLE IV—EXECUTION TIMES FOR SAMPLE INSTRUCTIONS**

<table>
<thead>
<tr>
<th>Time (μs)</th>
<th>Instruction</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8</td>
<td>ADD.L D0,D1</td>
<td>Add the 32-bit register D0 to D1 and put the sum in D1</td>
</tr>
<tr>
<td>1.2</td>
<td>MOVE.W (A0),(A1)</td>
<td>Move the word pointed to by A0 to the location pointed to by A1</td>
</tr>
<tr>
<td>7.0</td>
<td>MULS D0,D1</td>
<td>Multiply the signed 32-bit integer in D0 by D1 and put product in D1</td>
</tr>
</tbody>
</table>

Another typical 16-bit CPU is the Mostek MK68200 optimized for control applications. It contains 4K bytes of ROM, 256 bytes of RAM, and three 16-bit timers. It can be slaved to a 68000. The MC68010 supports virtual memory and virtual machine, terms formerly associated only with mainframes.

The next few years should see a considerable number of 68000-compatible chips coming into wide usage.

In the software arena, the 68000 has over 40 independent software vendors working on 68000 packages. In high-level languages, everything from FORTH to ADA is available. In operating systems, Motorola is announcing UNIDOS, a UNIX version 7 compatible operating system. Digital Research is also to produce a CP/M-68K to take advantage of the 8-bit standard CP/M.
The latest trend in miniaturization has produced two new types of disks battling it out between themselves and perhaps the established larger floppies.

A MAJOR trend in computer technology today is toward size reduction. Digital computers were once behemoths that occupied large rooms. They gave way, however, to minis that could be rack-mounted or placed on a large desktop. Then came the microcomputer, producing another order of size reduction. The past couple of years has seen still another size reduction with the introduction of the battery-powered "pocket" or "handheld" computer that can be carried in an ordinary briefcase or...
Select 5 fact-filled volumes for only $2.95 (total value up to $89.75)

7 very good reasons to try Electronics Book Club
Blue Ridge Summit, PA 17214

- Reduced Member Prices. Save up to 75% on books sure to increase your know-how
- Satisfaction Guaranteed. All books returnable within 10 days without obligation
- Club News Bulletins. All about current selections—mains, alternates, extras—plus bonus offers. Comes 13 times a year with dozens of up-to-the-minute titles you can pick from
- "Automatic Order." Do nothing, and the Main selection will be shipped automatically! But . . . if you want an Alternate selection—or no books at all—we'll follow the instructions you give on the reply form provided with every News Bulletin
- Continuing Benefits. Get a Dividend Certificate with every book purchased after fulfilling membership obligation, and qualify for discounts on many other volumes
- Bonus Specials. Take advantage of sales, events, and added-value promotions
- Exceptional Quality. All books are first-rate publisher's editions, filled with useful, up-to-the-minute information

Electronics Book Club
Blue Ridge Summit, PA 17214

Please accept my membership in Electronics Book Club and send the 5 volumes circled below, billing me $2.95 plus shipping and handling charges. If not satisfied, I may return the books within ten days without obligation and have my membership cancelled. I agree to purchase 4 or more books at reduced Club prices (plus shipping/handling) during the next 12 months, and may resign any time thereafter.

335 1045 1123 1160 1183 1191 1211 1233 1241 1249 1271 1275 1276 1283 1290 1316 1332 1337 1339 1349 1390 1396 1409 1411 1420 1429 1435 1436 1465

Name ___________________________ Phone ___________________________
Address ___________________________
City ___________________________ State ___________ Zip ___________

(Valid for new members only. Foreign and Canada add 20%. Orders outside Canada must be prepaid with international money orders in U.S. dollars.)

This order subject to acceptance by Electronics Book Club
CE-1182

November 1982

CIRCLE NO. 8 ON FREE INFORMATION CARD
even stored in one's jacket pocket.

In line with computer size reduction, data storage devices have also undergone great dimensional changes. Large magnetic drums were once used to store data, but the introduction of the low-cost microcomputer led to the development of reasonably priced, relatively small 5 1/4" and 8" floppy-disk systems so common today.

Of course, data expands to fill the available storage media, so new approaches were found to increase the amount of data that could be stored on popular disks. From the original single-density modulation technique that allowed about 90K bytes on a diskette, came double-density that allowed twice the amount of data to be stored. Some manufacturers have even started to produce quad-density diskettes. There is still no standard for these techniques, however. Today, one can get about 300K bytes on a 5 1/4" and approach one megabyte on an 8" diskette.

Since physical size is important to the creation of small computers, drive manufacturers started to deliver slender mechanisms (still using the 5 1/4" and 8" diskettes), giving birth to low-profile packages that are coordinated with the sleek look of a modern computer enclosure.

Now we are on the verge of a new generation—the "3-inch" floppy diskette system that not only offers a great size reduction, but an even greater storage density. Although designated a floppy diskette, only the internal media is floppy since the diskette is housed in a rigid enclosure. Currently, there are two major small-disk competitors: the 3-inch Compact Floppy Disk (CFD) developed jointly by Hitachi Ltd., Matsushita Electric Industrial, Hitachi Maxell, Ltd., and TDK Electronics Corp. versus the Sony 3.5-inch Micro Floppydisk.

Although many manufacturers, including Dysan, Shugart, Verbatim, Tabor, Xidex, Olivetti, Brown Disc Mfg., Micro Peripherals Inc., and BASF are having meetings to determine the specifications for the new small diskette, no standards have been set as of this writing. The standards group will first concentrate on the packaging—soft or hard jacket—then will cover the media's magnetic characteristics. It will present its findings at an upcoming fall meeting of the American National Standards Institute (ANSI).

However, several computer manufacturers are jumping on one bandwagon or the other. Amdek, Brown Disk, and Otrona, for example, are leaning toward the Hitachi approach, while Jonos Ltd. and...
It's like having X-ray ears...

Tiny, powerful electronic “ears” let you hear whispers through walls, conversations 2 miles away.

The Dyna-Mike Transmitter

It’s smaller than a quarter. But DYNA-MIKE will transmit every sound in a room to an FM radio tuned to the proper unused frequency, from 1/4 mile to 2 miles away.

If you’re at a neighbor’s home a block from your own, you can hear your baby’s cry, or you can tell the instant your spouse comes home. If two of you are driving tandem in two cars, one or both of you can communicate with the other even if other cars drive between you.

DYNA-MIKE has as many uses as your imagination can think of. For a business con-

ference, let the tiny microphone sit unobtrusively on the table or concealed on a shelf, and you’ll be able to record every word. For businesses, you can put an FM receiver in a warehouse or remote office and “broadcast” instructions or orders to be filled.

Public speakers never had a better friend than the DYNA-MIKE. No wires or setup — just turn on one or more radios and your speech will come through with perfect fidelity. Put one on the front porch. If you hear a suspicious sound, turn on the radio and you’ll hear the doorbell or the ring of the telephone.

Choose Your Model

New Horizons is introducing three models of the DYNA-MIKE supersensitive broadcast microphone. Model IC-18 is the world’s smallest microphone — it’s a miracle of electronic miniature power, with a high-fidelity range of 1800 feet. Introductory price is $129.95 (two for only $119.95 each).

Model X-18 is the longest-range microphone, with an unbelievable two-mile range. Introductory price is $149.95 (two for only $139.95 each).

Model X-3 is the most sensitive microphone. It broadcasts perfect-quality sound even from low-levels or whispers, up to 1,500 feet. Introductory price is $99.95 (two for only $89.95 each).

Each microphone is fully wired, complete with standard HC-1,35v. battery, good for 100 hours of continuous use and easily and inex-

pensively replaceable.

Of course you’re protected by the New Horizon guarantee: use any DYNA-MIKE transmitter microphone for 30 days, with the right to return it for a full refund if you’re not delighted.

— Phone or use this coupon —

The Super-Ear

You’ll hear it all.

Effortlessly, you can hear not just a baby’s cries, but quiet breathing, through a concrete wall a foot thick. Put the SUPER-EAR earphone in your ear and place the speaker on the wall. That’s all there is to it.

SUPER-EAR hears everything, and even more astonishing, hears it clearly. It’s as though the wall weren’t there. If you’re coming home late at night and think intruders are in your residence, let SUPER-EAR find out for you.

Want to know if the meeting is over in the room with the closed door? SUPER-EAR will tell you in seconds.

SUPER-EAR is undetectable from the other side of the wall. The quality of sound has amazing fidelity — good enough to record, and SUPER-EAR has its own built-in recorder jack.

Because SUPER-EAR is the ultimate listening device, you can use it to pinpoint hidden squeaks in your car or the source of mysterious engine noises.

Construction experts use it to check for flaws or cracks in buildings.

It Works Anywhere!

Ever put your ear to a railroad track to try to hear the train? Try it with SUPER-EAR. You’ll hear that train many miles away. Use it as a powerful stethoscope on yourself, a friend, or a pet. You can even hear a bird’s breathing.

The only source for SUPER-EAR is New Horizons. Choose from two models — Model SB-5, with ultrasonic microphone, $139.95 (two for only $129.95 each); or Model SB-1, with suction-type microphone, $99.95 (two for only $89.95 each).

Use your SUPER-EAR for 30 days. If for any reason you’re not delighted, the absolute New Horizons guarantee means you can return it for a prompt refund.

The Phone Answerer Recorder

The PHONE ANSWERER/RECORIDER connects in seconds between any tape recorder and your telephone. When you’re away it automatically delivers a message up to 20 seconds to anyone who calls: when you’ll return, when to call back, where you are.

When you’re there, the ANSWERER/-RECORIDER starts any cassette recorder automatically when you pick up the phone and shuts off when you hang up.

It records both sides of the conversation with astonishing clarity, giving you a permanent record of every call, preventing unauthorized use of your phone, and eliminating misunder-

standings over what was said. It’s specially wired to extend recording time on your tape recorder. Needs no batteries — it’s always “alive”.

The PHONE ANSWERER/RECORIDER is a masterpiece of miniaturization. It’s yours for $49.95 (two for only $44.95 each), PHONE RECORIDER unit alone, records but doesn’t answer, $29.95 (two for $24.95 each). Every instrument has the unbeatable New Horizons guarantee.

For immediate service on credit card orders, call toll-free 24 hours a day, seven days a week:

1-800-824-7888

Ask for operator NO. 551 in California: 800-852-7777

We Absolutely Guarantee! Use any electronic instrument acquired from us for up to 30 days. If you decide for any reason that you don’t want to keep it, return it for a 100% refund.

NEW HORIZONS

1 Penn Plaza, Suite 100
New York, N.Y. 10119
For Information Call (201) 370-8029

November 1982

CIRCLE NO. 17 ON FREE INFORMATION CARD

97

AmericanRadioHistory.com
Hewlett-Packard, among others, have elected to go the Sony route. The parameters of both types of diskette are shown in the diagrams on the preceding page.

Physically, the approaches are very similar, although the diskettes are not interchangeable. Each is about half the size of a conventional 8" diskette and about 60% the size of a 5¼" unit. In both cases, the recording media has a rigid case that provides mechanical protection, and each has a sliding shield that automatically covers the head hole when the diskette is removed from the drive. Each is also provided with a solid rim that surrounds the drive hub hole to prevent diskette warping when the drive is engaged to the soft recording media.

The major difference shows up in track density and rotational speed. Sony's new head allows 135 tracks per inch with a data track width of 125 microns and a guard band of 63 microns. The gap length of the read/write head is 2 microns while rotational speed is 600 rpm. The Hitachi approach uses 100 tracks per inch. To allow its microdisk to gain acceptance, the rotational speed (300 rpm), data transfer rate, recording capacity per track, and other specifications are essentially the same as conventional 5¼" systems. The diskette magnetic coating has the same recording capacity as a double-density 5¼", making it possible to transmit data from a 5¼" disk to the 3" microdisk using a similar controller. Specifications for both approaches are shown in the Table.

There is no question that the small diskette will be improved to give higher densities and capacities. The development of perpendicular recording, where the magnetic domains run through the magnetic media, rather than along the media as conventionally used, could produce a considerable increase in data storage. It is quite possible at this time to produce microdiskettes having one-megabyte storage using the double-sided version, increasing the storage density to possibly 100 megabytes.

**Drives.** As the diskette size dropped, so did the physical dimensions of the drives. However, the apparent size drop in this area is greater than the difference between the diskettes themselves. Although the microflop diskette is about 60% of the size of a conventional 5¼" diskette, the floppy disk drive volume appears to be about 75% smaller than the 5¼" drives. This is important when designing systems for small computers since more data storage can be packed into the same valuable space.

The Sony OA-D30V drive is 4"W × 2"H × 5"D. The Hitachi
HFD 3055 is 3 1/2" W × 1 1/2" H × 6" D. Both of these are single drives. Amdek Corp., is producing a dual-drive package called the Micro-Floppydisk for the 3" diskette whose dimensions are a mere 7" W × 4" H × 8" D. TDK is currently talking to Shugart about the 3" (Hitachi) and say that they will talk to any drive manufacturer that displays an interest in the new small disk.

Tandon who is looking into the Sony approach, uses a double-sided diskette that can support 875K bytes, and a drive that is only 1 1/8" H × 4" W × 6 1/2" D.

**Winchester Drives.** Not only are floppy diskettes and their drives getting smaller, hard disks are also on the way down. Sony is soon to introduce its 3 1/2" hard disk that will offer 3 to 10 megabytes using conventional recording, increasing to 10 to 100 megabytes using perpendicular recording. They also claim to have removable media under consideration.

The SyQuest SQ306 is a 3.9-inch Winchester disk drive with removable cartridge media. Unformatted, this disk has a 6.38-megabyte capacity, with 5-megabytes formatted. Its half-height form factor, just 1.625 inches high, allows two of these drives to be located in the same physical space as a single 5 1/4" drive. It is fully compatible with the Seagate ST506/406 5 1/4" fixed Winchester drive, and uses the controllers designed for the ST506/406 such as the DTC, 510A, XEBEX 1410, and the Western Digital WD 1000. The removable cartridge media requires no purge cycle upon power up and is engineered for 10,000 insert/removal operations. Price of a disk pack is less than $30 in OEM quantities.

The SyQuest features a fully digital closed-loop embedded servo that extends the accuracy of the metal-band positioner to 100 microinches. The embedded burst servos, where the control data resides within a single wedge per track, allows full definition control of sector formats. An on-board microprocessor verifies track position after each seek and adjusts for any positioning errors.

---

**THE SINCLAIR ZX81 Programming for Real Applications**

Randle Hurley

Here are 11 fully documented programs which will cast aside any beliefs that the ZX81 is too small for any real programming work.

These programs not only work—they are true work horses, doing real jobs in a variety of environments. Designed to run with the 16K memory module, the programs include a bulk storage program, word processor, financial applications, banking uses, plus educational programs.

Software available on cassette and can be ordered from back of book. Programs will also run on the Timex Sinclair.

156 pages $9.95

YES, Please send me THE SINCLAIR ZX81 by Randle Hurley. I understand I may return it for a full refund if I am not satisfied.

☐ I enclose $9.95 plus $1 to cover the shipping and handling.

☐ Or call our toll free number 800-547-1842 to charge your order on VISA OR M/C.

☐ Please send me your free catalog.

Name __________________________ 

Address __________________________ 

City, State, Zip ________________ 

MAIL TO: dilithium Press, P.O. Box 606, Beaverton, OR 97075. 

---

**NEW FOR THE HOBBYIST/PROTOTYPE...**

**DC SOLDERING WITH DIGITAL TEMPERATURE CONTROL**

FOR ONLY $189.00!

Complete with DC power cord, 4"x4" removable stand.

At last, precision digital soldering temperature control in a compact, DC operated, portable package. Micro Matic lets you make precise adjustments at soldering temperature to suit individual job. Temperature settings are adjustable in one degree increments over the full 80°F to 680°F operating range.

This microprocessor-based unit won't keep you waiting during warm-up. It's ready within 90 seconds, and reaches new temperature settings in 15 to 20 seconds. Just dial in the desired temperature and The brilliant digital display removes all guesswork. Micro Matic draws only 7.5 watts under full load. That's almost like soldering for free! It's compact — weights only 6 ounces. Designed for trouble-free operation in critical soldering jobs. Fully guaranteed. Balanced for agility, comfortable to hold and easy to maneuver around delicate circuits. An array of interchangeable tips are available to accommodate a very soldering requirement. Whether assembling hobby projects or creating prototype printed circuit boards, Micro Matic is the lightweight, lightweight-heatweight tool for the job.

To expedite your order call the factory (213) 988-6644. MasterCard and Visa charge orders accepted. California residents please add 6.5% tax.

**Conquer Critical Soldering Jobs with the Micro Matic DC Soldering System!**

---

**belle de st. claire**

16147 Valero St., Van Nuys, CA 91406 (213) 988-6644

DIAMOND MARKET PLACE

December 1982
...AUDIO TESTS

the output stages become overheated (as when the outputs are shorted). A second system, the Sentry Monitoring Circuit, responds instantly to excessive drive or load current that could damage the output devices, and restricts the drive signal to keep their heat dissipation at safe levels. A third protection circuit monitors the speaker outputs for any dc component (which could signal an internal failure). Within milliseconds of detecting any dc, this circuit disconnects the speaker outputs.

The McIntosh Power Guard is a unique protection against waveform clipping, which is audibly irritating and can damage speakers. It compares the input and output waveforms and if the disparity between them correspond to about 0.5% distortion, a red LIMIT warning light appears on the panel. A further increase in signal level does not increase the output level, yet the limiting action creates no audibly significant distortion, no matter how great the overload.

**Laboratory Measurements.**

Driving 8-ohm loads at 1000 Hz, the McIntosh MA6200 delivered 98 watts per channel at the point where the LIMIT light came on. (This criterion was used in lieu of "clipping," which could not be induced.) The maximum 4-ohm output was 151 watts per channel. These corresponded to Clipping Headroom ratings of 1.16 dB and 1.8 dB, respectively. With 2-ohm loads, the maximum output was about 66 watts per channel, but the thermal protection shut down the amplifier rapidly at levels greater than 50 watts.

When we used the 20-millisecond tone bursts of the IHF Dynamic Headroom measurement, the maximum output readings were 111 and 178 watts respectively for 8- and 4-ohm loads, corresponding to Dynamic Headroom ratings of 1.71 dB and 2.51 dB. The dynamic output into 2 ohms was roughly the same as the maximum continuous.

Harmonic distortion at 1000 Hz with 8-ohm loads was under 0.002% up to 30 watts, reaching 0.0034% at the rated 75 W and 0.17% at 100 W, well into the Power Guard limiting range. With 4-ohm loads, the distortion rose from 0.0018% at 1 W to 0.014% at the rated 100 W, and 0.022% at 150 W. The 2-ohm distortion rose from 0.0034% at 1 W to 0.025% at 50 W.

At the rated 75-W output into 8 ohms, the distortion was 0.004% to 0.005% from 20 to 7000 Hz, rising to 0.011% at 20,000 Hz. Distortion decreased as power was reduced. The high-frequency linearity was measured with the two-tone IHF-1M test signal. Equal amplitude inputs at 18 and 19 kHz drove the amplifier to the same peak level as a 75-watt sine-wave signal. The second-order difference products at 1000 Hz, and the third order distortion products at 17 and 20 kHz, were measured on a spectrum analyzer. All were in the range of 75 to 77 dB below 75 W, a negligible value. The slew factor of the amplifier exceeded our measurement limit of 25, and it was stable when driving reactive-simulated speaker loads.

Through the high-level inputs (TUNER or AUX) the amplifier required a 30-mV signal for a 1-W reference output, and the A-weighted noise in the output was 86 dB below 1 W. Through the phono input, the sensitivity was 0.21 mV, and the noise was −82 dB. The phono input overloaded at 95 to 100 mV, depending on frequency. The phono input had a resistance of 48 kOhms, shunted by about 25 pF. The RIAA equalization was accurate within 0.5 dB overall, from 30 to 20,000 Hz, and down about 1 dB at 20 Hz.

The loudness compensation worked as specified. As the control was advanced, the midrange level (500 to 1500 Hz) decreased by about 1 dB, while the bass response reached a maximum of about +19 dB at 33 Hz (or 20 dB above the depressed midrange level). Above 2000 Hz, the entire response was elevated to a maximum of +3 dB relative to the midrange level.

**User Comment.** It should hardly be necessary to point out that the McIntosh MA6200 has no sound quality of its own. Its freedom from distortion and noise, complete lack of switching transients or crosstalk between inputs, immunity to over-load or other distortions, and extensive protection circuitry combine with excellent overall electrical performance to make this one of the most satisfying and elegant audio products we have had the pleasure of using.

The unusual loudness-compensation characteristic proved to be one of the most listenable we have encountered. It was easy to supply a feeling of full deep bass at low listening levels, without the artificial heaviness that mars most so-called "loudness controls." Similarly, flexibility of the 5-band tone control was as great as we can imagine anyone needing in a home music installation. Each knob had its distinctive, easily recognizable effect on the sound, leaving little doubt as to the optimum setting of the controls for any particular situation. We also found the rotary knobs easier to use than the more commonly employed slider controls. At their center (detented) positions, they gave a response flat within ±0.25 dB from 20 to 20,000 Hz.

Not only is it impossible to make this amplifier distort by overdriving it, we also found that its protective systems make it practically immune to damage. For example, an inadvertent reversal of output leads during one test effectively shorted both outputs, which were driven at high levels for some time. The LIMIT lights signalled that something was amiss, but our wiring error was not detected until after the amplifier's thermal protection shut off its outputs. After a cooling period, it returned to service, none the worse for treatment that would have destroyed most amplifiers.

The McIntosh MA6200 is an expensive amplifier, if judged only on the basis of price. However, when one considers the manufacturer's well-deserved reputation for reliability and long-term support of its products, the MA6200 would be a most reasonable choice for someone who is looking for perhaps the finest possible, nondeteriorating performance over many years of use.

—Julian D. Hirsch

CIRCLE NO. 101 ON FREE INFORMATION CARD
THE MASTER HANDBOOK OF IC CIRCUITS

By Thomas R. Powers

Here's a useful encyclopedia of 932 different circuits, using more than 212 popular ICs. Six sections (Linear Integrated Circuits, Voltage Regulators, CMOS Integrated Circuits, TTL/LS Integrated Circuits, Radio and Television Integrated Circuits, and Special Purpose Devices) provide information on build-it-yourself projects like high speed op amps, RC active filters, audio bass boosters, NOR gates, and clock pulse generators.


FIBER OPTICS

By Edward A. Lacy

The use of fiber optics is becoming increasingly widespread. This book focuses on their operating principles, e.g., internal reflection, bandwidth capacity, resistance to interference, etc. The author gives a very thorough overview of why and how fiber optics can be used in various applications. The devices associated with fiber optics are discussed, with attention to splicers, connectors, couplers, and photodiodes. Typical systems that use fiber optics are dealt with briefly.


PRACTICAL BASIC PROGRAMS

Edited by Lon Poole

This is a book of actual programs in BASIC. It is intended for those who have already mastered one or more microcomputer versions of that language, e.g., Applesoft BASIC, Atari BASIC, TRS-80 BASIC, etc. Each program begins with a general description of a common problem in financial analysis or business management, together with a specific example of the task to be accomplished. Then the actual program listing is written out step-by-step.

Published by Osborne/McGraw Hill, Berkeley, CA. Soft cover. 171 pages. $12.50.

November 1982
A monthly column devoted to answering your questions on computers

By Stan Veit

IN THIS new column, we will select questions from readers that we feel will be most useful and answer them as best we can. We cannot, of course, answer all of the questions we receive on an individual basis, but here are some recent queries we have received regarding computers and applications.

NO OTHER CARTRIDGE, AT ANY PRICE, GIVES YOU ALL THESE FEATURES...

Exclusive MICROWALL/Be™ Stylus Shank
This incredible stylus Shank—a Shure exclusive feature—combines the high stiffness and low mass of pure Beryllium, with a revolutionary ultra-thin wall tubular construction, to offer the lowest effective mass of any stylus Shank available. The result is high frequency trackability at an unbelievable 60 cm/sec (peak velocity) for unprecedented reproduction of high frequencies and a truer, more musical sound, with greatly reduced record and stylus tip wear.

Exclusive Dynamic Stabilizer Destaticizer
This Shure exclusive feature rides record warps (present on all records) like a shock absorber to eliminate audible "wow," distortion, groove skidding and cartridge bottoming, while reducing record wear.

TheDestaticizer consists of 10,000 electrically conductive fibers that discharge static electricity while removing microscopic dust particles from the record groove. This eliminates "pops" caused by static and debris.

Exclusive Hyperelliptical MASAR™ Polished Stylus Tip
The Hyperelliptical (HE) stylus tip has larger, narrower contact areas to provide an audible advantage over spherical and elliptical stylus tips, giving you pure, natural, musical sound without distortion.

The stylus/groove contact areas are MASAR-polished to reduce friction at the interface between record and stylus, for less wear on both.

The end result is the most accurate reproduction, with the least record and tip wear you can get from any phono cartridge.

$50* U.S. Savings Bond Bonus with the purchase of a V15 Type V Phono Cartridge until December 31, 1982.

Call for the Name of the Dealer Nearest You. 24 Hours a Day, 7 Days a Week. 800-323-6556 Ask for Dept. R15
In Illinois: 800-942-6345 Ask for Dept. R15

*Value at Maturity

Shure Brothers Inc., 222 Hartrey Avenue, Evanston, IL 60204

DISK STORAGE SPACE
Q. I have been learning to use UCSD Pascal on my Apple II and I think I understand it. But when I complete a program, in the Editor and Quit, and try to either write it to the disk or compile it, I get an error message that tells me I do not have enough room on the disk to store the program either as a TEXT file or as a CODE file. I end up losing all my work; and then, when I look at the directory listing, it tells me I have enough blocks left to store the program! Why does this happen?—Robert Sales, Anaheim, CA.

A. When you go into the FILER, do an extended directory listing by using the E command. You will notice the amount of storage space in blocks that you have left in the largest remaining space. That is really the amount of usable space you have left—no more. The rest of the space is scattered throughout the disk in noncontiguous space. The systems can only save in contiguous blocks of storage space. So when your edited text or compiled code is larger than this amount, you get the error message.

When there is not enough room to save your work, you end up losing it unless you can substitute a formatted diskette with a system on it and enough room to save your text file. USCD Pascal needs at least a 56K system to run at all. The 64K in an Apple II does not leave much room for long programs. You must watch your disk storage space and crunch them to avoid wasting space. It is a good idea before you write a program to go into the FILER and do an extended directory listing to observe how much contiguous space remains on the disk. If there is not enough space, you can delete unneeded code or text files and then use the Krunch command to crunch diskette storage. As an alternative, you can make a diskette with only the system elements you need and no other files on it. This will maximize space. Refer to the UCSD System Manual for names of files you must have in a minimum system.
A. Although the Install program has a provision for a Centronics-type parallel interface, the driver software may not exist, or there may be small differences between the requirements of your printer and the characteristics in the driver routine provided. There is a much surer way to make your printer work with Wordstar (or any other word processor with an Install program). This method depends on the fact that CP/M is device-independent. It normally outputs to a device that has been declared to be "The List Device" or LST. This is a serial device accessed from a serial port. The normal CP/M printer device is referred to as the Line Printer or LPT. This is normally a parallel device accessed from the parallel printer port. Now the STAT program in CP/M provides the method of making any normal CP/M device the List Device by declaring it to be so. For example STAT LST: LPT: makes the line printer the List device. Now we can use the Wordstar Install program to create a version that outputs to a Teletype printer and the CP/M List Device. We give it a name to identify it and it becomes our usual version of Wordstar.

Prior to loading our new version of Wordstar, when the CP/M prompt appears, you say STAT LST: (cr). Then, CTRL "P" should cause whatever you type to be sent to the printer where it will be printed. Now load the new version of Wordstar and compose your text. When you issue the PRINT command, it will be sent to the printer.

**COMPUTER FOR BUSINESS**

Q. We are about to buy a personal computer to use in our business, the principle use of which will be applications using electronic spreadsheets. Can you help in selecting a matching for this purpose?—I. Fila, Racine, WI

A. Electronic spreadsheets such as VisiCalc, SuperCalc, Calcstar, and others have one characteristic in common. They use larger amounts of memory. While they all display the same size empty matrix on the screen, when you enter a template or data, they need considerable memory to store your applications. Be sure that the computer you select permits you to add memory that is usable by the spreadsheet program you want to use. Some computers restrict you to a maximum of, say, 48K for the complete system. This is very restrictive for spreadsheet program work.

---

**HOTLINE**

**USING A PRINTER**

Q. I have a Centronics-type parallel printer that I want to use with Wordstar on my computer. The trouble is that the version I bought is set to use a serial printer. I've tried to use the Install program supplied with Wordstar to make a version that will work with a parallel interface and it still won't print. Can you help?—Bernard Green, NY

---

**NEW!**

Choose from four new titles in TI's Understanding Series™

<table>
<thead>
<tr>
<th>Title</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding Electronic Security Systems</td>
<td>LCB7201</td>
</tr>
<tr>
<td>Understanding Electronic Control of Energy Systems</td>
<td>LCB8642</td>
</tr>
<tr>
<td>Understanding Electronic Control of Automation Systems</td>
<td>LCB8641</td>
</tr>
<tr>
<td>Understanding Telephone Electronics</td>
<td>LCB8741</td>
</tr>
</tbody>
</table>

All books $6.95. Check choices below.

- Learning Center Library Catalog — CM110 (No charge)
- Understanding Electronic Security Systems — LCB7201
- Understanding Electronic Control of Energy Systems — LCB8642
- Understanding Electronic Control of Automation Systems — LCB8641 (JAN 83)
- Understanding Telephone Electronics — LCB8741 (DEC 82)
- Understanding Automotive Electronics — LCB5571
- Understanding Solid-State Electronics — LCB3361
- Understanding Digital Electronics — LCB3311
- Understanding Microprocessors — LCB4023
- Understanding Communications Systems — LCB4521
- Understanding Computer Science — LCB4571
- Understanding Optics — LCB4572
- Understanding Calculations — LCB3321

Enclose check or money order with sales tax (except AK, DE, NH, OR). Foreign orders must be in U.S. dollars and include shipping charges. No phone orders, please.

Name: __________________________
Address: _______________________
City: __________________________ State: ______ Zip: ______

Prices subject to change without notice.

© 1982 TI

November 1982

---

**Texas Instruments HOTLINE**

[Continued on next page]
A Universal Active Filter Breakthrough

By Forrest M. Mims

ANYONE working with or designing active filters would probably welcome a simple approach to their implementation. An ideal solution would be a single integrated circuit providing low-pass, band-pass, high-pass, and notch filtering without requiring external components. The ideal active filter would be tunable, consume little current, and be compatible with CPUs and other digital circuits.

Several years ago Datel (now Datel-Intersil, Inc., 11 Cabot Blvd., Mansfield, MA 02048) introduced the FLT-U2 Universal Active Filter. Manufactured with thick-film, hybrid technology, it employs three operational amplifiers to implement second-order low-pass, band-pass, high-pass, and notch transfer functions. The FLT-U2 includes a fourth, uncommitted op amp that can be used as a gain stage, buffer, or summing amplifier, or for additional filtering (such as implementation of a notch filter).

The FLT-U2 can operate over a frequency range of from 0.001 Hz to 200 kHz. Its block diagram (Fig. 1), reveals that many of the passive components necessary to implement the various filter functions are already present. This means, for example, that a band pass filter can be made by adding only four external resistors.

More recently, National Semiconductor (2900 Semiconductor Drive, Santa Clara, CA 95051) introduced the MF10 Universal Monolithic Dual Switched Capacitor Filter. Unlike the FLT-U2, this filter is a monolithic CMOS chip and is therefore easier to fabricate. Its current consumption is 10 mA, about the same as the FLT-U2.

The MF10 is a switched-capacitor filter, a standard analog filter in which fixed resistors are replaced by a network of switched capacitors under the control of an external clock. The clock frequency determines the center or corner frequency of the filter.

The MF10 contains two independent active-filter building-block stages. Each block requires an external clock and from three to four external resistors to implement any of the various filter functions.

A major breakthrough in active filter technology has been achieved by EG&G Reticon (345 Potrero Ave., Sunnyvale, CA 94086). It is the R5620, the first fully integrated universal active filter. Like National's MF10, the R5620 is a switched-capacitor filter that requires an external clock. Filter parameters, however, are selected digitally and no external resistors or capacitors are required.

The corner or center frequency for the R5620's particular operating mode is selected from any of 32 frequencies for a specific clock frequency. The frequencies are spaced logarithmically over two decades. The overall frequency range for the filter is 0.05 Hz to 25 kHz. The Q of the filter can be set to one of 32 logarithmically spaced values ranging from 0.57 to 150.

Figure 2 shows the various connections to the R5620. Note that the filter has separate inputs for each of its modes. The Q and frequency-control inputs can be hardwired or selected by BCD mechanical switches, logic circuits, or a microprocessor. The chip consumes only about 3 mA and operates from a power supply of from ±4 to ±10 V. Small quantity pricing for this sophisticated chip is around $8.00.

Although the R5620 represents a major breakthrough in active filter technology, it doesn't necessarily solve all application problems. As you can see in the accompanying table, the more traditional design of the FLT-U2 provides a considerably wider operating range. While the R5620 has a more limited range, it's ideally suited for applications in which digital control and tuning are required.

---

**Fig. 1. Internal block diagram of the FLT-U2.**

**Fig. 2. External connections to R5620 Universal Active Filter.**

---
Incredible as it may seem, Popular Electronics helped launch the microcomputer industry. Back in 1975, we published plans for building the first powerful microcomputer based on the 8080 cpu. These plans generated incredible excitement—and started the world thinking about personal computing.

Since then, we've added more coverage of personal computing. Today, so much of the magazine is devoted to microcomputers that we've changed our name to...

**Computers & Electronics**

**Computers & Electronics** continues the Popular Electronics tradition of helping our readers experience the advances of the future—today. We do it with clearly written, in-depth articles explaining each innovation...plans for building useful, money-saving projects incorporating the newest technology...reviews of the latest mass-produced equipment. Whether it's microcomputer equipment, audio, video, or personal electronics, Computers & Electronics will make it possible for you to enjoy the newest, the most sophisticated, the most innovative technology around.

**Helpful buying guides**

Computers & Electronics compares and contrasts computers and other electronics gear in meaningful buyer's guide articles. We discuss features and options, what to look for, and how to get the best value. Recent buyer's guides have covered computer printers, pocket computers, sophisticated telephones, video cassette recorders and high-tech audio cassettes.

**World-famous test reports**

In every issue of Computers & Electronics you'll find our famous in-depth test reports. We take a new product, test it and analyze the results. Recently we've tested the Radio Shack TRS-80 Model III, the IBM Personal Computer, and the Sinclair ZX-81. Microcomputers by Apple, Atari, Hewlett-Packard, Intel, and others. Plus an interactive data terminal, software, and a variety of audio, video and testing equipment.

**Innovative construction projects**

If you're a do-it-yourselfer, you'll love the construction projects in Computers & Electronics. Not only do we bring the world the first successful microcomputer kit, but also projects for building the first low-cost modem. The first computer keyboard integrated with the computer (SOL).

The first low-cost voice synthesizer. The first low-cost logic analyzer. The first 8080-based microcomputer (ELF). The first low-cost function generator. The first gas-laser communicator (awarded a place in the Smithsonian Institution). The first low-cost color graphics computer module. An interface to transfer narrow line listings from your TRS-80 Pocket Computer to either a printer or CRT screen.

As you can see, our construction projects, while not necessarily complex (thanks to multifunction IC chips), will keep you at the forefront of technological development—at remarkably low cost. And in the future, we'll be bringing you construction projects to help you make your microcomputer more useful—whether it's an enhancement, an application, or a merging of technology with external controls and products.

**Get the leader in the field—at up to 33% off!**

Computers & Electronics is the world's most widely read computer and personal electronics magazine. Now you can subscribe at big savings: up to 33% off. At our New Subscriber rates, a one-year subscription is only $12.97. Take advantage of this offer—complete and return the coupon or postage-paid reply card today!
A New CMOS Microcontroller. Four-bit dedicated microcontrollers are widely used in a host of consumer applications. Recently, there's been a major swing from NMOS to CMOS microcontrollers, and now the number of CMOS units is nearing the NMOS total.

One of the latest CMOS microcontrollers is an addition to National Semiconductor's COPS family of 4-bit controllers. The new controller is available in six versions that provide various temperature ranges and I/O capacities.

The first two chips in this new line are the COP410C and COP411C. The COP410C is housed in a 24-pin DIP and has 20 I/O lines. The COP411C has 16 I/O lines and is packaged in a 20-pin DIP.

Power consumption of the new chips is substantially less than their NMOS counterparts. The NMOS COP410L, for example, consumes 15 mW while the CMOS COP410C consumes only 40 µW. Furthermore, the CMOS part is much faster. When operated from a 5-V supply, its minimum instruction cycle time is only 4 µs, 11 µs faster than the NMOS version.

These new CMOS microcontrollers retain the internal architecture and features of the NMOS versions including 41 instructions, a two-level subroutine stack, and I/O lines that can be designed for specific requirements (CMOS, TTL and 3-state interfacing). The new microcontrollers include 32 nibles of RAM and 512 x 8 bit user-specified masked ROM. Custom-programmed versions of the new chips will be available in volume for about $3.00 each.

A Videotex Graphics Chip. At last summer's Videotex '82 Conference and Exhibition in New York, Jean Guillerman, chairman of Antiope, announced a new graphics generator chip that provides high-resolution graphics and text for Videotex terminals. The new chip is a video-display processor used in conjunction with a microprocessor, memory, and possibly a modem. It can operate with either the 525- or 625-line television standards, and can provide a resolution of 80 dots per character space.

Several operating modes for the new chip are available. In its text mode, the chip can display 20 to 25 rows having up to 40 characters per row. In its captioning mode, the chip will insert text onto a graphics background. The combined graphics and text mode provides full-bit-mapping capability, 320 points by the number of the monitor's scan lines, all NABTS graphics primitives, and eight colors (expandable to sixteen).

Jean Guillerman is also the president and chief executive officer of Telediffusion de France, the French public common carrier and research laboratories for all radio and television in France. The announcement of the new chip was accompanied by a statement pointing out the advantages of high-resolution graphics for Videotex and emphasizing that "France is fully prepared to support such activities in the United States." For additional information, contact Herbert L. Corbin, an Antiope media representative (99 Park Avenue, New York, NY 10016).

High-Power Semiconductor Lasers. A research team from Xerox Research Center in Palo Alto, CA has developed a new kind of semiconductor injection laser capable of continuously emitting up to 400 mW at room temperature. This represents a major advance over previous high-power semiconductor lasers.

The new laser incorporates ten parallel stripes that provide an ar-
...SOLID STATE

CONVERTERS
DESCRAMBLERS
Largest Selection
of Equipment Available
$ Buy Warehouse Direct & Save $

36 channel
converter $45.95

36 channel
wired remote
converter only $88.95

Send $2 for complete catalog
of converters and scramblers

Quantity Discounts • Visa • Master Charge
Add 9% shipping—Much residents add 4% sales tax

C&D Electronics, Inc.
P.O. Box 21, Jenison, MI 49428
(616) 669-2440

Put Professional Knowledge and a
COLLEGE DEGREE
in your Electronics Career through
HOME STUDY

Earn Your
DEGREE
No commuting to class. Study at your
own pace, while continuing your present
job. Learn from easy-to-understand less-
sons, with help from your home-study
instructors whenever you need it.

In the Grantham electronics program,
you first earn your A.S.E.T. degree, and
then your B.S.E.T. These degrees are ac-
ccredited by the Accrediting Commission
of the National Home Study Council.

Our free bulletin gives full details of
the home-study program, the degrees
awarded, and the requirements for each
degree. Write for Bulletin ET-82.

Grantham College of Engineering
2500 So. LaCienega Blvd.
Los Angeles, California 90034

ray of active regions. Each stripe is
3 micrometers wide and extends the
length of the laser. The radiation
from adjacent stripes is optically
coupled to provide phase locking and
transverse mode stability.

When operated in a pulsed mode
(1 kHz @ 75 nanoseconds), one of
the new lasers exhibited a lasing
threshold of about 300 mA. It emitted
2.1 W from its front facet before irreversable catastrophic damage
occurred. The peak wavelength of
the GaAlAs device was 832
nanometers.

In a continuous mode study, the
average onset of catastrophic dam-
age to the new lasers was about 370
mW per facet. The total power
conversion efficiency was a remarkable
17%.

In a fiber-optic communications
role, these new lasers can inject
more optical radiation into a fiber
than any previous LED or diode la-
sers. In a preliminary test, a 5-meter
length of large core (100-micro-
meter diameter) fiber was coupled
to one of the new lasers with an
insertion loss of — 3 dB. The optical
power emerging from the free end
of the fiber measured 150 mW,
approximately seven times greater
than the results of previous such
demonstrations reported in the
literature.

While Xerox may have an inter-
est in the communications potential
of these new lasers, their very high
output power makes them prime
candidates for such applications as
printing and video disk writing.

MORE GAIN
THAN A VARACTOR UHF TUNER

Satisfaction Guaranteed
$15.00
Free, Range UHF470-880MHz Channels 1-493
Output Channel 3.
Available on request: Ch 2 to 4

1. The first thing we do is change the standard
diode found in every tuner to a Hot Carrier
Diode.

2. The tuners output is first measured and
compared to our computer derived chart
from which we determine the correct
value coil to add across the IF output for
maximum Pre-Peaked gain.

3. The tuner is fed a standard 10db antenna
input, and while monitoring the output on
our Spectrum Analyzer, the tuner is tuned
to the desired channel and its oscillator
is shifted for the desired output frequency as
follows:

Ch 2:58Mhz Ch 3: 63Mhz Ch 4: 68Mhz
We call this tuning because the tuner output looks like
a peak on our spectrum analyzer and the highest point of that
peak is actually adjusted for the desired output.

4. Finally, we measure the tuners output one
more time which is again compared to our
computer derived performance chart
to ascertain the correct value of the
second coil which is added to the tuners internal
connections.

This procedure was developed by GILCO and its computer
derived performance charts that make our tuner betten. That's
because almost every tuner gets a different value coil before it's
peaked and then a different value coil after it's peaked. The
combinations are endless and the way we determine the values
is our secret.

PRINTED CIRCUIT BOARDS

Part No. B21 Printed Circuit Board...$17.00
1. This Printed Circuit Board uses only one
ic, jumper, others use 9
2. The component layout is screen printed on
the Component side of the pre-drilled P/C
Board.
3. The solder side of the P/C Board is covered
with High Temperature Solder Resist for
ease of assembly.
4. This P/C board was designed to take advan-
tage of the Gilo High Gain Tuner which means its
circuitry is simpler and more efficient than
current UHF tuners that require interior Varactor Tuners.

ELECTRONIC PARTS KITS

Part No. B22 Complete Parts Kit....$80.00
All resistors (30), Potentiometers (1-5K, 3.10K), Panel Mount
Potentiometers (10K), Electronic Capacitors (6), Ceramic and
Mylar Disc Capacitors (35), Variable Capacitors (4), All Inter-
grated Circuits (7), Voltage Regulator, Heat Sink, Trimmers (4), IC
Sockets (4-8 pin, 3-14 pin), Power Transformer (2KV/1A), Coil
Kits with No. H6 winding wire (5), Speaker (4 - 3 Oz.), Stents,
Coaxial cable. All misc, Hardware, etc. All parts are individually
packaged and labeled.
All components including the wire, Hardware, Coaxial Cable and
Heat sinks are included in the parts kit. This means your as-
ssembly time from start to finish is only 4 hours.
Order all 3, B20, B21, B22....$110.00
Order 5 each, B20, B21, B22...$95.00/set

ACCESSORIES: AMPLIFIERS

Part No.
A01 New 2 Stage Low Kit $18.00
Noise 26db gain RF
Amplifier Specially
designed for kit builders
A02 New 1 Stage Low Kit $10.50
Noise 14db gain Amplifier
A03 75-300 OHM matching Transformer...
$1.00
F59 Coaxial Connectors...$0.30
Mail order only. Send check or money order to:
GILCO INTERNATIONAL, INC.
P.O. Box 8817, Coral Gables, FL 33124
Tel: (305) 853 5891 For COD orders add 10% shipping
and handling or for orders over $50 add 5%.
FL residents add 5% sales tax. Please write for more information.
BUY YOUR COMPONENTS
THE WAY DESIGN ENGINEERS DO... 
... in kits — direct from the manufacturer — that give you:
- all the values you need for prototyping, breadboarding, new designs, and replacement...the current ratings most used by O.E.M design engineers for computer, instrument, power supply, and general consumer/industrial applications
- the latest production components
- highest quality; every item guaranteed
- the best prices

Here are only a few of the many Capar Professional Component Kits available with special pricing,

CAE-DE: 100 axial lead aluminum electrolytic capacitors, 0.01 mfd through 0.47 mfd, 10 WVDI through 50 WVDI, ± 10% tolerance $19.95 (reg $25)
CRF-DE: 150 radial lead aluminum electrolytic capacitors, 0.01 mfd through 2200 mfd, 10 WVDI through 50 WVDI, ± 10% tolerance $19.95 (reg $25)
CLE-DE: 100 subminiature, low leakage, radial lead aluminum electrolytic capacitors, 0.1 mfd through 47 mfd, 10 WVDI through 50 WVDI (4 x 7 mm) $15.90 (reg $20)
CDT-DE: 100 radial lead dipped tantalum capacitors, 0.1 mfd through 100 mfd, 3.15 WVDI through 35 WVDI, ± 10% tolerance $25.90 (reg $35)
CCF-DE: 150 radial lead ceramic disc capacitors — general purpose and temperature compensating, 10 mfd through 0.2 mfd, 50 WVDI through 1 kw WVDI, Hi-K and T-C types, ±10% tolerances $29.95 (reg $35)
CCF25-DE: 350 carbon film 1/2-watt 5% resistors, 1 ohm through 10 megohms $7.95 (Reg $10)
CCF50-DE: 350 carbon film 1/2-watt 5% resistors, 1 ohm through 10 megohms $7.95 (Reg $10)
CFM-DE: 75 radial lead metalized polyester film capacitors, 0.01 mfd through 2.2 mfd, 100 WVDI through 630 WVDI, ± 10% tolerance $19.95 (reg $25)
CMB-DE: 100 radial lead metalized polyester film capacitors, "box type", 0.01 mfd through 1.0 mfd, 100 WVDI through 630 WVDI, ± 10% tolerance $19.95 (reg $25)
CEM-DE: 150 radial lead, polyester film capacitors, epoxy dipped, inductive type, 0.001 mfd through 0.47 mfd, 100 WVDI ± 10% tolerance $19.95 (reg $25)
Add $1.50 per order for postage & handling.

CAPAR COMPONENTS CORP.
25 Dubon Ct. Farmingdale, NY 11735

Send the following kit(s):

Name .
Address .
City .
State .
Zip .
Enclose check or money order $ .

Plus postage (UPS) $ .

Total $ .

Send free kit catalog In New York call: (212) 464-8689

CIRCLE NO. 45 ON FREE INFORMATION CARD

108 Computers & Electronics

COMPUTER BITS

Notes on Using Your System as a Secretary

By Carl Warren

OCCASIONALLY, when I'm on the road at article deadline time, I have sent material directly to the office via computer link. I use an Orona Attaché portable computer with Metalogic's Whizlink communication package and a Hayes Microcomputer Smartmodem for this purpose.

At the home end, I've implemented the Hayes 1200-baud Smartmodem with Ward Christophenson's computer bulletin board system (CBBS*), as well as his public domain BYE program.

Although the CBBS can be used by anyone, I've modified it for private use and added a mailbox function in concert with the Hayes modem. With Ward's help (and a very large phone bill), I've been able to implement several functions. I can call in to either upload or download items, leave a message to my secretary coupled to an alarm function (the system beeps until she answers it or I command it off), or leave a special system message.

This last function, the system message, currently relies on the system clock (which, unfortunately, is thrown off by disk accesses) to perform date/time tasks. (Eventually I plan to add the Hayes Stack Chronometer). This unique system message permits the entering of a date, time, and phone number to call. At the specified time, the number is dialled and sign-in is established. After the transfer is completed, the system signs off.

Even though this mailbox function may seem trivial in concept, we found that we had to take into account a number of things that might go wrong. Besides power outages and glitches, you need to know that you do, in fact, have a valid carrier and have connected. The Hayes modem handles this. Next, you must be able to determine that you have achieved a valid sign-on and have proper communication. The modem can't perform this function, so we had to look further.

In designing the mailbox, we found that Ward had provided all the CP/M system level handlers to move messages. What was missing, however, was the handling mechanism for the mailbox functions. Since we needed reasonable speed and ease of programming, we turned to the command language in Ashton Tate's dBase II management system.

Essentially we had to perform string comparisons to make sure the functions were valid. We also had to manipulate files that could be text, data, or command structures. Since CBBS allows the creation of message files that are handled by the structure in a way similar to that of dBase II all we needed to add in CBBS code was a call to dBase II letting it manipulate all the message files.

Rather than allow CBBS to create the file—which it can do—we always default to dBase II. The message files are defined as:

CODE 3,C (3 ASCII characters long)
PHONE 15,C (Up to 15 ASCII characters)
CONTENTS 200,C (Up to 200 characters)

System displays this as:

CODE: PHONE:

Total message is 200 characters

To further simplify the message system, a Control-Q displays a list of codes and phone numbers (we allow up to ten). In this mode, all we do is enter the desired code (I'll explain this shortly) and the phone number. The system automatically fills in the correct information. An enhancement I plan later is a switch that calls a file for the message. This will permit messages of greater than 200 characters.

The code that I mentioned is a
FOR ONLY $129.95
Learning Computer
From The Ground Up

Build a Computer kit that grows with you, and can expand to 54
RAM, Microsoft BASIC, Text Editor/Wrasser, Modem, Floppy Drive.

EXPLORER/85
Here’s the low cost way to learn the fundamentals of comput-
ing. for all important basics you’ll need more and more. Just add computer-related hardware and software to the
package you get when you advance the designer. Explorer/85.

Microsoft BASIC, Text Editor/Assembler, Hard Drive, Floppy Drive, Modem, Printer, Diskette drives.

To order, call: 800-243-7428

Continental Credit Card Buyers Outside Connecticut
TO ORDER Call Toll Free: 800-243-7428
To Order From Connecticut Or For Technical Assistance, Call (203) 354-9375

POS OR NEG

You get all this in the starting level (Level A) of the Explorer/85 for only $289.95. Incredible! Just plug in
and you’re on your way. As you advance, you can plug in all your own peripheral devices, one-by-one.

A.C.T. terminal with all IBM compatible programs, including mine. 

80按 button.

LENS: 0.98x plus 2x option.

You get all this in the starting level (Level A) of the Explorer/85 for only $289.95. Incredible! Just plug in
and you’re on your way. As you advance, you can plug in all your own peripheral devices, one-by-one.

A.C.T. terminal with all IBM compatible programs, including mine. 

80按 button.

LENS: 0.98x plus 2x option.
unique indicator directly related to what I want to do. The code is made up of three characters.

The first (leftmost) character is either a D or an F. D is for dial from the date and time in the first line of the message. An F uses a special call file for the date and time. The second and third characters set up the attributes of the transfer:

- **CM** — call and send only;
- **CD** — call and send then delete;
- **CS** — call, send, and look for messages.

The latter function only works with similar systems that are expecting a message query.

One of the features of the Whizlink communication program is its ability to reduce the size of a file by 40% using a compression system, which speeds communications. We found that we could use the compression file from Whizlink in concert with our modified CBBS. (Currently, we have only tested this in a local loop and not on the operating CBBS so we aren't sure we have all the links properly implemented.)

Unfortunately, we don't have room in the magazine to publish the code we created, but we can make it available via the COMPUTER & ELECTRONICS Bulletin Board found on CompuServe. When on CompuServe, type GO PEM-450 and look in the access file (function XA).

If you want to duplicate the procedures described here, you'll need to contact Ward Christenson (via CompuServe's bulletin board) for the CBBS package and purchase a Hayes Smartmodem. There are other intelligent modems available, but the Hayes system is the only one we have used. In addition, we have our system on a Zenith Z89 with a Magnolia disk controller and a combination of 8" and 5 1/4" drives.

Unfortunately, the BIOS (basic input/output system) implemented by Magnolia differs enough from the Zenith version to require a redefinition of the location of the TPA (transient program area) in CBBS.
EXPERIMENTER'S CORNER

Experimenting with Kodak's Disc Camera
Part 1. Modifying the Camera for Electronic Triggering

By Forrest M. Mims

Kodak's new system of disc photography has been widely acclaimed as an important development in snapshot photography. The disc camera system opens up a wide range of applications for experimenters who wish to add electronic accessories to the basic camera.

Each of the four cameras in the disc family combines a motorized film advance, built-in strobe, batteries, and totally electronic triggering in a rugged package that weighs only six ounces and is sold for as little as $45. These features make the disc cameras ideally suited for many fascinating assignments that otherwise require hard-to-find, costly equipment and accessories.

Many electronic accessories for the disc camera family can be designed. Some of the more obvious include a variable-speed sequence controller and circuits that remotely trigger the camera in response to light, sound, or radio signals. Applications for a disc camera and one or more accessories such as these are wide ranging. A sound-activated disc can photograph wildlife or an unwanted intruder. A light-triggered disc can record lightning or serve as a combination slave flash and camera. A sequentially triggered disc camera can take elapsed-time photos of flowers opening, cloud movements, and traffic patterns. It can also be used to provide a timed photographic record of an instrument panel or a sequence of zones through which a vehicle or aircraft has passed. A radio- or infrared-triggered disc has numerous applications in remotely controlled photography.

However, until Kodak introduces a disc camera with an external socket or jack suitable for connecting various triggering devices, it is necessary to modify one of their existing units for special control purposes. I'll describe how that is accomplished later. First, let's find out more about the design and operation of the cameras in the Kodak disc family.

The Disc Camera Family. Thus far, Kodak has announced four disc cameras: Models 2000, 4000, 6000 and 8000. The four have many features in common. Each is about the size of a pocket calculator (1" x 3" x 4.5") and includes motorized film advance and a built-in strobe. All four accept a 15-exposure flat film cartridge that contains a unique rotating disc of Kodacolor HR film. All the cameras also include a fixed-focus, 4-element, all-glass lens system with a focal length of 12.5 mm and a fully open aperture of f/2.8.

The Kodak disc 2000 is a low priced version of the camera which, though made in the United States, is currently sold only in countries other than the U.S. and Mexico. It is powered by a replaceable 9-volt alkaline battery and lacks the fully automatic features of the three other disc cameras.

The Kodak disc 4000, Fig. 1, includes a built-in light sensing integrated circuit with a threshold of 125 footlamberts. Above that value, the camera provides an exposure speed of 1/200 second at a lens aperture of f/6. Below it, exposure speed is automatically reduced to 1/100 second and the lens aperture is opened fully to f/2.8. Furthermore, the electronic strobe always flashes when the light level is below 125 foot-lamberts.

A second 16,000 square mil integrated-injection logic chip housed in a miniature 18-pin DIP makes the timing and control decisions necessary to charge the flash capacitor, fire the strobe, select the lens aperture and exposure speed and advance the film disc. The chip drives the camera's 6-volt slot-car-type motor at an average power of 2 watts and a peak current of 2 amperes.

The flash capacitor is fully charged in less than a second. Combined with the automatic film advance feature, which rotates the film disc to the next frame in 0.4 second, the camera can therefore take flash photographs at intervals of only 1.5 seconds!

The Kodak disc 4000 is powered by a pair of 3-volt lithium polycarbon monofluoride batteries made by Panasonic, making it one of the first consumer products to be powered by this exceptional energy source. These batteries are reported to have a shelf life in excess of five years and a capacity of 1200 milliamper hours.

The Kodak disc 4000 is housed in a robust plastic and silver anodized aluminum case. A sliding lens and viewfinder cover automatically actuates the strobe capacitor charging circuit when the camera is made ready for use.

The Model 6000 is identical to the Disc 4000 with two exceptions. The first is a folding cover that protects the entire front of the camera when it is not in use. When opened, the cover serves as a handle. It also automatically actuates the strobe capacitor charging circuit. The second addition to the disc 6000 is a close-up lens that can be quickly slid into action by moving a small protrusion under the lens opening. The close-up lens reduces the minimum picture taking distance from 4 feet to 18 inches.

Fig. 1. Kodak's disc 4000 can be purchased for less than $45 in many discount stores.
The disc 8000 is the most sophisticated of the family. It incorporates the close-up lens and cover of the disc 6000 plus a self-timer, a rapid sequence film advance and a digital alarm clock. The self-timer provides a 10-second delay before the camera automatically takes a picture, thus allowing the user to be included in a photograph. The timer activates a blinking red LED on the front of the camera and an audible, pulsating tone. The tone sequence speeds up during the final two seconds before the exposure is made to notify the user the camera is about to be triggered.

The rapid sequence feature of the disc 8000 permits the camera’s user to take photos at a rate of three per second in daylight simply by holding down the shutter button. If the flash is needed, the camera will take a picture once every 1½ second when the shutter button is held down. The digital alarm clock has its own power supply.

The Film Disc. Figure 2 shows a processed 15-exposure disc color negative. The Kodacolor film has an ISO speed of 200 and the film has twice the speed and a finer grain than Kodacolor II film.

The disc in Fig. 2 includes frame numbers and both alphanumeric and bar-coded identification codes. These data as well as the individual frame numbers are prefashed on the film when it is manufactured and made visible during development.

Modifying a Disc Camera. To modify a disc camera, you have at least two options. One is to employ a servo or solenoid to electromechanically trip the existing shutter button. The other is to gain access to the camera’s circuitry and attach a set of external connection leads.

The advantage of the electromechanical approach is that there is no need to open the camera, thus protecting its warranty. On the other hand, the electromechanical approach requires more space, is heavier, consumes more power, and is less reliable than purely electronic triggering.

I’ve modified two disc 4000 cameras by removing the front panel and soldering connection leads directly to the cameras’ circuit boards. I’ll describe how this is done next, but first here are a few precautions you must heed.

1. Kodak’s warranty is voided “...if the camera is damaged by misuse or other circumstances beyond Kodak’s control...” Since the manual provided with the disc cameras specifically states that the camera should not be disassembled, opening and modifying the camera might be grounds for voiding the warranty. On the other hand, if a malfunction is not associated with a modification, the warranty might stand. But you should be aware of the risks.

2. Unless you are careful and follow the instructions given below, you might damage the camera. You must avoid touching or manipulating the complex and fragile mechanical parts of the camera. You must also avoid bridging solder across adjacent terminals on its circuit board.

3. The camera’s built-in strobe circuitry constitutes a potential shock hazard.

The primary shock hazard is a 160-microfarad photoflash capacitor which is almost always charged to about 180 volts. Even weeks after the camera is last used, this capacitor retains a hefty charge! The discharge from this capacitor across a finger or hand can cause an involuntary jerk that may dump a soldering iron in your lap or jam your elbow into a wall. A discharge through your body (as from one hand to the other) may cause a more severe reaction. Therefore, you should open the camera only if you know what you are doing and if you plan to use the proper precautions.

For example, when the camera is open, never touch any part of the circuit board or any electronic parts or components with your fingers or an uninsulated tool. There’s no need to touch anything inside the camera to make the modifications to be described. Furthermore, you should always keep one hand away from the camera to avoid a possible shock through your body. Of course, you should not open the camera at all if you have had no prior electronics experience.

Opening A Disc Camera. Opening a disc camera requires a clean work area and a steel implement about half-a-millimeter thick and a centimeter or so wide. It should be at least 10 centimeters long. A 15-centimeter stainless steel pocket rule like those available at hardware stores works reasonably well. Avoid the temptation to use a screwdriver! It will damage the case and may slide up inside the camera.

You want to remove the aluminum front cover with its attached black plastic lens and viewfinder door assemblies. Along the bottom of the camera there is a narrow gap between the aluminum front cover and the...
camera's plastic body. Look closely and you'll see two slots in the gap on either side of the camera. With the lens facing away from you, the widest of the two slots is to your left.

Make sure the camera's lens door is fully closed. Then insert the steel tool into the widest of the two slots and twist the tool from side to side until the aluminum cover begins to give. Repeat this procedure with the slot on the right side of the camera's bottom. Be patient. Several cycles of twisting and prying may be necessary to remove the cover. Above all, don't force the tool or push it up inside the camera's body, where it might damage the circuit board or delicate moving parts, or even cause a shock.

Eventually you will be able to lift the cover from the camera. Figure 3 shows what you will see. Avoid getting dust on the lens and do not touch any of the camera's internal parts.

**Connecting External Shutter Lead.** When the camera is opened, make a 1-millimeter hole in the bottom of the camera at the location shown in Fig. 4. Use a small drill or simply twirl a sharp hobby knife into the plastic. Remove any protrusions or cuttings from inside the case. Incidentally, if you select a different location for the shutter leads' access hole, make sure it does not interfere with the protruding lips of the camera front panel.

Next, notice the square opening in the yellow plastic circuit board protective cover. The three rectangular pads visible through the opening are the shutter contacts. You may solder external connection leads directly to them, but to avoid complications you may then have to remove the flexible contacts from the shutter switch on the back side of the camera's cover panel. Of course, this will permanently disable the camera's manual shutter switch.

Alternatively, you can do as I have done and temporarily remove the yellow circuit-board cover in order to solder the leads to the terminal points of the lands leading away from each of the three shutter switch pads. **CAUTION:** To avoid being shocked by the strobe capacitor, do not touch the exposed circuit board! See the safety remarks previously given.

Since the early versions of the disc camera used at least two entirely different circuit-board layouts, I've not included a photograph of my modified cameras, each of which employed a different circuit board. But all you have to do is follow the land leading away from each shutter switch pad to its end point and carefully solder an 8" length of wrapping wire to each terminal. See Fig. 5 for the color-coding arrangement you should use.

Only a few millimeters of insulation need be removed from one end of each wire. Do not remove any insulation from the opposite end of each wire. Use a low-wattage soldering pencil to make the connections.

---

**All styli are not created equal.**

When you select a phonograph cartridge, the cost will be strongly influenced by which stylus design you choose. Least expensive is the UniRadial (spherical or conical). A simple design, simply made. Or, a performance cartridge with a Line Contact (Shibata) tip whose shape permits the best high frequency tracing, yet whose long, narrow bearing face reduces groove pressure for longer record and stylus life. Add a positively-indexed square shank, plus laser-beam alignment of micro-polished surfaces and you have the finest stylus design available today. Make your choice with Audio-Technica. You'll hear the difference.

---

November 1982
and be careful to avoid bridging solder between the closely spaced terminals on the board. A rubber-bulb solder slugger will remove solder bridges.

After leads are in place, inspect the board to find and remove any solder balls or bits of wire. Make sure the soldered ends of each wire do not extend away from the terminals and contact any nearby terminals or lands. Next, clip off any exposed wire from the end of each lead. Then thread the three leads through the hole in the bottom of the case. Pointed electronic tweezers will be very helpful. Again, do not touch the circuit board! If necessary, insulate the tweezers with vinyl tape. Pull the wires so they extend in a gentle curve over the two batteries and then carefully replace the adhesive yellow cover over the circuit board. There's no need to touch the board. Just allow the cover to fall into position on the board and press it in position with the eraser end of a wood pencil.

Finally, replace the camera's cover. First, make sure...
the arrangement of the shutter contacts in the disc camera. When the shutter is lightly pressed or merely touched, the upper two contacts close to activate the strobe capacitor charging circuit. Opening the lens door has the same effect.

You can hear a brief, high-pitched hum from inside the camera when this occurs. For more volume, place the camera near an AM radio and touch the shutter button. The speaker will emit a brief but noisy hum (or a few clicks if the capacitor is already charged).

To trip the shutter, the upper two contacts must make contact with the lower contact. The exposure is then made and the film disc is automatically advanced to the next frame. You can accomplish this with your modified camera by removing some insulation from the end of each lead, twisting the blue and white strobe charging leads together and touching them to the red lead. Disconnect the blue and white leads to save a few mils of current drain. You can use a pair of miniature switches to manually trigger your modified disc camera. Add longer connection leads, and you can take pictures from across the room.

To Be Continued. In Part 2 I’ll describe a variety of straightforward but very versatile accessories for your modified disc camera. In a subsequent column we’ll fly a radio-controlled disc camera from kites and balloons.

The Best Arcade Simulation Software for Your TRS-80® Brought to You by Soft Sector Marketing, Inc.

ALIEN DEFENSE
by Larry Ashmun

Piloting your ship across the horizontally moving terrain, you must battle the various enemy spacecraft. You are under attack almost constantly from missiles and bombs, to make matters worse, your ground patrol people are being picked up by the alien landers. To save them you must shoot the landers and swoop down to “catch” the falling man. This fast-action game requires skill and rapid reflexes. The Model III version makes excellent use of that model’s special graphic features and both Mod I and Mod III disk versions TAUX. Arcade simulation 1982.

CATERPILLAR
by Larry Ashmun

You are being attacked by a raging caterpillar. As he creeps down the valley, you must destroy it or be destroyed. If you escape from the first one you will have only survived to fight another. Beware of the trained killer moth and tumblebugs. Another exciting arcade simulation brought to you by Soft Sector Marketing, Inc.

FORTRESS II
by Larry Ashmun

A super-fast paced arcade game. Defend your fortress from alien fighters, but watch out for the sneak attack. The game starts out slow but speeds up very quickly.

ALIEN DEFENSE
by Larry Ashmun

SKY SWEEP
by Mark Barlow

OUTHOUSE
by Factory Programming

There is no place sacred? Even the outhouse has been invaded. Ward off intruders who creep up to the outhouse to snatch the paper supply. At the same time you must defend yourself from their firing ships in the sky. Be very careful, when your paper supply is gone... so are you! With sound and disk version.

Prices Per Game:

<table>
<thead>
<tr>
<th>Game</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRS-80 16K Level II Mod I/Mod III Cassette</td>
<td>$15.95</td>
</tr>
<tr>
<td>TRS-80 16K Level II Mod I/Mod III Disk</td>
<td>$19.95</td>
</tr>
</tbody>
</table>

10% discount for 2 items, 15% for 3 or more. 

Call or Write Us for Complete Catalog!

Soft Sector Marketing
P.O. Box 340 - Garden City, MI 48135
Order Line 800-521-6504
Michigan Orders & Questions 313-425-4020

November 1982

CIRCLE NO. 52 ON FREE INFORMATION CARD
Regency Scanners

Our radios deliver the kind of performance you need. For rugged day-to-day operations in practically any type of environment, Regency scanners can take it. So they're the first choice of professionals all around the country. And when you think about it, what else would you expect from the only professional two-way radio manufacturer in the scanner business. We've taken the features you want, and incorporated them into our scanners. . . . base, mobile and hand held.

So listen to your channels on your choice of a wide variety of models and prices from Regency—makers of the world's first transistor radio.

Model R106

Model H604

Regency Electronics, Inc.
7707 Records Street
Indianapolis, Indiana 46226

Model M100

CIRCLE NO. 6 ON FREE INFORMATION CARD

SEE YOUR DEALER TODAY

FROM

Firestik Antennas & Accessories
GOLDEN SERIES

BARE-HANDS TUNABLE "NO TOOLS NEEDED"
HIGH PERFORMANCE ANTENNAS

ALSO ANTENNAS FOR CORDLESS TELEPHONES
MONITOR SCANNERS

Dealer & Distributor Inquiries Invited
SEND FOR FREE CATALOG

Firestik Antenna Company
2614 East Adams/Phoenix, AZ 85034

CIRCLE NO. 43 ON FREE INFORMATION CARD

OPERATION ASSIST

If you need information on outdated or rare equipment—a schematic, parts list, etc.—another reader might be able to assist. Simply send a postcard to Operation Assist, Computronics & Electronics, 4324 1st Ave., New York, NY 10016. For those who can help readers, please respond directly to them. They'll appreciate it. (Only those items regarding equipment not available from normal sources are published.)


Tektronix Model 422 oscilloscope. Need CRT V959. Clyde Warner, 3901 Coventry Road, Fayetteville, NC 28304.


Tektronix Model S54U oscilloscope. Need data on transistor U1064/2 npt. P.E.A. Hertz, 40 Baden Powell Road, Northend, Bulawayo, Zimbabwe.

Polytronics Lab Inc., Model PC-73 23-channel CB. Need schematic and operating manual. Steve Alva, P.O. Box 1904, Paso Robles, CA 93446.


Microswitch Model 113SDS keyboard. Need schematic, operating manual or any available information. Doug Chase, 7915 Paia St., San Diego, CA 92114.


Knight Kit Model 223102XW star roamer. Need schematics, assembly manual and any other pertinent information. Richard Barton, 325 Sago Avenue, Jacksonvillle, FL 32218.

Panorama Model RDP 1CP565161 oscilloscope. Need operating instructions and schematic. G. Stern, 23-80 26th Street, Long Island City, NY 11105.


Elco Model 751 ac power supply. Need schematics or owner's manuals. Richard Benol, 533 Ridgecrest Road, N.E., Atlanta, GA 30307.

CIRCLE NO. 46 ON FREE INFORMATION CARD

BUILD YOUR OWN TROUBLE FREE OSCILLOSCOPE

Engineered by Heath Co. and Manufactured for use by RCA Institutes

Ideal and inexpensive for Professional Service Technicians, Students, and Experimenters

A five-inch scope, designed for the needs of service technicians — a stable instrument operated at a high degree of dependability — a trouble-free performer. Formerly RCA Inst. Model 625.

Easy to assemble. Two modern printed circuit boards to reduce point-to-point wiring. Combined simple instructions and operating manual included.

Frequency response from 3 Hz to 5 MHz; + 1.5 db. The response at 3.58 MHz color TV carrier is + 2.2 db. Special features include two preset adjustments to facilitate instantaneous oscillator lock-in for TV vertical and horizontal sweep circuits. Test communication equipment (including CD's), Hi-Fi's, Radios and TV's. Order your scope.

A $250 value — Now only $189.50

New Jersey Residents add 5% sales tax.

Electronics Technical Institute
Dept. 473-112, Little Falls, N.J. 07424

Enclosed is my check for $189.50, or charge on my credit card below. Send me the Oscilloscope Kit, postage paid. Credit card order call 800-526-0890 toll-free

Name ____________________________
City ____________________________
State __________ Zip __________

(VISA) (MasterCard) (Carte Blanche)

Card Number __________ Expiration Date

Serving the CB and Communications Market Since 1962.

5-YEAR REPLACEMENT WARRANTY

CIRCLE NO. 44 ON FREE INFORMATION CARD

Computers & Electronics
ACTIVE RECEIVING ANTENNA

Gives excellent reception, 50 KHz to 30 MHz.

New MJF-1024 Active Receiving Antenna Mounts outside away from electrical noise for maximum signal. Gives excellent reception of 50 KHz to 30 MHz signals. Equivalent to wire hundreds of feet long. Use any SWL, MW, BC, VLF or Ham receiver.

High dynamic range RF amplifier, 54 inch, 240 foot coax. 20 dB attenuator prevents receiver overload. Switch between two receivers. Select auxiliary or receive antenna. Gain control. "ON" LED. Remote unit, 3x2x4 in. Control 6x2x5 in. 12 VDC or 110 VAC with optional adapter. MJF-1312, $9.95.

Order from MJF and try it. If not delighted, return within 30 days for refund (less shipping). One year unconditional guarantee. Order today. Call TOLL FREE 800-647-1800. Charge Visa, MC, or mail check, money order.

Write for free catalog of 110 products.

CALL TOLL FREE 800-647-1800

Box 494, Mississippi State, MS 39762

CIRCLE NO. 26 ON FREE INFORMATION CARD
Introducing incredible tuning accuracy at an incredibly affordable price: The Command Series RF-300 31-band AM/FM/SW receiver. No other shortwave receiver brings in PLL quartz synthesized tuning and all-band digital readout for as low a price. The tuner tracks and "locks" onto your signal, and the 5-digit display shows exactly what frequency you're on.

There are other ways the RF-3100 commands the airways: It can travel the full length of the shortwave band (that's 1.6 to 30 MHz). It eliminates interference when stations overlap by narrowing the broadcast band. It improves reception in strong signal areas with RF Gain Control. And the RF-3100 catches Morse communications accurately with BFO Pitch Control.

Want to bring in your favorite programs without lifting a finger? Then consider the Panasonic RF-6300 8-band AM/FM/SW receiver (1.6 to 30 MHz) has microcomputerized preset pushbutton tuning, for programming 12 different broadcasts, or the same broadcast 12 days in a row. Automatically. It even has a quartz alarm clock that turns the radio on and off to play your favorite broadcasts.

The Command Series RF-3100 and RF-6300. Two more ways to roam the globe at the speed of sound. Only from Panasonic.

*Shortwave reception will vary with antenna, weather conditions, operator's geographic location and other factors. An outside antenna may be required for maximum shortwave reception.

Based on a comparison of suggested retail prices.

This Panasonic Command Series shortwave receiver brings the state of the art closer to the state of your pocketbook.

With PLL Quartz Synthesized Tuning and Digital Frequency Readout.

Panasonic just slightly ahead of our time.
Listen to your planet on a shortwave receiver!

Communications Electronics, the world's largest distributor of radio scanners, is pleased to introduce Panasonic Command Series shortwave receivers. Panasonic lets you listen to what the world has to say. Unlike a scanner, a Command Series radio lets you listen to shortwave broadcasts from countries around the world, as well as the U.S.A. It's the space age shortwave performance you've been waiting for...at a down to earth price you can afford.

All Panasonic shortwave receivers sold by Communications Electronics bring the real live excitement of international radio to your home or office. With your Command Series receiver, you can monitor exciting radio transmissions such as the BBC, Radio Moscow, Ham Radio and our own Armed Forces Radio Network. Thousands of broadcasts in hundreds of different languages are beamed into North America every day. If you do not own a shortwave receiver for yourself, now's the time to buy your new receiver from CE. Choose the receiver that's right for you, then call our toll-free number to place your order with your credit card.

We give you excellent service because CE distributes more scanners and shortwave receivers worldwide than anyone else. Our warehouse facilities are equipped to process thousands of orders every week. We also export receivers to over 300 countries and military installations. Almost all items are in stock for quick shipment, so if you're a person who needs to know what's really happening around you, order today from CE.

Panasonic® RF-6300
List price $749.95/CE price $529.00
Bands: LW 150-410 KHz, MW 520-1610 KHz, SW 1-30 MHz.
The new Panasonic RF-6300 Command Series PLL synthesized 8-band portable communications receiver, lets you hear the world. The RF-6300 has features such as microcomputer pre-set tuning and PLL quartz synthesized digital tuner. Microcomputer stores up to 12 different frequencies for push-button recall. FM/MWD/LW/SW1-5 reception. Manual tuning knob. Wide/Narrow bandwidth selector. Double superheterodyne system. Fast/Slow manual tuning. Built-in quartz digital alarm clock. 5 inch dynamic picture speaker. 3 antennas. Multi-voltage Detachable AC cord. Operates on 6 "D" batteries (not included). Made in Japan.

Panasonic® RF-6400
List price $549.95/CE price $399.00
Bands: MW 525-1610 KHz, SW1-8 1.6-30 MHz.
The RF-6400 is the latest member of the popular Panasonic Command Series family. Features include a 5-digit fluorescent display for all 8 SW bands, as well as for AM/FM switch operation. Full coverage from 1.6 to 30 MHz on SW covers SSB and CW. Premix Double Superheterodyne. Fast/Slow 2 speed tuning. AFC switch on FM, narrow/wide selectivity switch for AM and SW. Antenna trimmer. Calibration control. SET RF circuit. Mode switch for AM-CW/SSB. BFO Pitch control. ANL switch for AM, RF gain control. Tuning-Battery meter with meter function switch. Separate bass and treble tone control. Dial light switch. Digital display off/on switch. Separate power switch. Rack type handle. Made in Japan.

Panasonic® RF-3100
List price $369.95/CE price $269.00
Bands: MW 525-1610 KHz, SW1-29 1.6-30 MHz, FM 88-108 MHz.
The new RF-3100 portable 31-Band portable radio has PLL Quartz-Synthesizer tuning that "locks" onto SW stations. Operates on AC or battery. SW frequencies from 1.6 to 30 MHz, are in 29 bands. All-band 5-digit frequency readout. Horizontal design with front mounted controls for shoulder strap operation. Double superheterodyne for clean SW reception. BFO pitch and RF gain controls. Separate bass and treble controls. Wide/Narrow bandwidth selector. Meter for tuning and battery strength. LED operation indicator. Meter light switch. 3½" PM dynamic speaker. Comes with detachable shoulder belt. Battery power (6 "D" batteries not included). Made in Japan.

Panasonic® RF-2900
List price $349.95/CE price $249.00
Bands: MW 525-1610 KHz, SW1-3 3.2-30 MHz, FM 88-108 MHz.

AmericanRadioHistory.Com
**Recommended Shortwave Programs by Time and Station**

By Glenn Hauser

Our previous compilation under this title drew such enthusiastic response that readers have persuaded us to present a new, updated, listing drawn from a much more extensive schedule that appears periodically in Review of International Broadcasting. Keep in mind that all times and days are GMT. Thus, at the beginning of the listing, the first few hours of "Saturday" are actually during Friday evening in North America. Times shown take into account those stations shifting programs due to the annual departure of DST Oct. 31. However, some frequency changes will be made Nov. 7.

**DX LISTENING**

<table>
<thead>
<tr>
<th>GMT</th>
<th>Station</th>
<th>Program &amp; Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>0010-0020</td>
<td>Kol Yisrael</td>
<td>T.G.I.F.; 11640, 9815 (also 0210)</td>
</tr>
<tr>
<td>0010-0035</td>
<td>R. Japan</td>
<td>Science &amp; Industry Journal; Editorial Roundup; 21610, 17825 (also 0155)</td>
</tr>
<tr>
<td>0015-0045</td>
<td>R. Peking</td>
<td>Profile; The Land &amp; the People; 17855, 17600, 15210 (also 0115, 0215, 0315, 0415)</td>
</tr>
<tr>
<td>0030-0100</td>
<td>R. Canada Int'l</td>
<td>Nightfall; 5960, 11850 or 9755</td>
</tr>
<tr>
<td>0110-0125</td>
<td>Kol Yisrael</td>
<td>Shabat Shalom; 11640, 9815</td>
</tr>
<tr>
<td>0130-0140</td>
<td>HCJB</td>
<td>Week in Ecuador; 17890, 15155, 9745</td>
</tr>
<tr>
<td>0130-0155</td>
<td>R. Budapest</td>
<td>Hungarian History; 11910, 9855, 9595</td>
</tr>
<tr>
<td>0145-0155</td>
<td>CBC</td>
<td>South Asia Survey; 9410</td>
</tr>
<tr>
<td>0210-0228</td>
<td>R. Budapest</td>
<td>Various Features; 11910, 9855, 9595 (also 0310)</td>
</tr>
<tr>
<td>0212-0225</td>
<td>R. Australia</td>
<td>Editorial Opinion; 21740, 17795 (also 0412)</td>
</tr>
<tr>
<td>0230-0245</td>
<td>UN Radio</td>
<td>UN-Africa; 15240, 6035</td>
</tr>
<tr>
<td>0330-0355</td>
<td>R. Tirana</td>
<td>Answering Listeners' Questions; 7300, 6200</td>
</tr>
<tr>
<td>0330-0359</td>
<td>BBC</td>
<td>Fiestas; 9410, 6175, 5975</td>
</tr>
<tr>
<td>0335-0359</td>
<td>BBC</td>
<td>Week &amp; Africa; 11860, 7105</td>
</tr>
<tr>
<td>0339-0355</td>
<td>R. Australia</td>
<td>This Australia; 17795</td>
</tr>
<tr>
<td>0400-0412</td>
<td>R. Budapest</td>
<td>Calling DXers &amp; Radio Amateurs; 11910, 9855, 9595</td>
</tr>
<tr>
<td>0530-0539</td>
<td>BBC</td>
<td>New Ideas; 9510, 9410, 6175, 5975</td>
</tr>
<tr>
<td>0535-0559</td>
<td>AFRTS</td>
<td>World of Religion; 6030 (also 1035)</td>
</tr>
<tr>
<td>0700-0800</td>
<td>Xandir Malta</td>
<td>Malta Calling; 9670</td>
</tr>
<tr>
<td>0715-0729</td>
<td>BBC</td>
<td>From the Weeklies; 9510, 9410, 6175, 5175</td>
</tr>
<tr>
<td>0830-0859</td>
<td>BBC</td>
<td>Comedy Series; 11955, 9510</td>
</tr>
<tr>
<td>0840-0905</td>
<td>R. Australia</td>
<td>This Australia; 11775, 9570</td>
</tr>
<tr>
<td>0912-1100</td>
<td>R. Australia</td>
<td>International Top Hits; 11775, 5995</td>
</tr>
<tr>
<td>0945-1014</td>
<td>BBC</td>
<td>Science in Action; 21660, 15070, 11750</td>
</tr>
<tr>
<td>1005-1025</td>
<td>V. of Vietnam</td>
<td>Vietnamese Music; 10080</td>
</tr>
<tr>
<td>1040-1050</td>
<td>R. Korea</td>
<td>Folk Tales &amp; Proverbs; 9570</td>
</tr>
<tr>
<td>1110-1115</td>
<td>HCJB</td>
<td>Musica Nacional; 11950, 9765, 6050</td>
</tr>
<tr>
<td>1110-1125</td>
<td>R. Australia</td>
<td>Editorial Opinion; 9580, 5995</td>
</tr>
<tr>
<td>1110-1125</td>
<td>VHEX, Haiti</td>
<td>Hobby of Kings; 11835, 9770</td>
</tr>
<tr>
<td>1135-1159</td>
<td>AFRTS</td>
<td>Meridian; 21710, 21660, 11750, 9710, 9510</td>
</tr>
<tr>
<td>1210-1230</td>
<td>R. Finland</td>
<td>Compass North; 21475, 15400 (also 1310 and 1410)</td>
</tr>
<tr>
<td>1211-1226</td>
<td>R. Moscow</td>
<td>Roundabout; 9600 Anything Goes; 21710, 21660, 11750, 9510</td>
</tr>
</tbody>
</table>

**SUNDAY**

<table>
<thead>
<tr>
<th>GMT</th>
<th>Station</th>
<th>Program &amp; Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>0015-0055</td>
<td>R. Peking</td>
<td>Chinese Sayings, Stories, Music; 9820</td>
</tr>
<tr>
<td>1230-1259</td>
<td>VOA</td>
<td>New York, New York; 9565, 9545</td>
</tr>
<tr>
<td>1255-1259</td>
<td>AFRTS</td>
<td>Portfolio; 15430, 15230, 11895, 9700 (also 1735)</td>
</tr>
<tr>
<td>1240-1255</td>
<td>R. Australia</td>
<td>Australian Inventor; 9580, 5995</td>
</tr>
<tr>
<td>1309-1334</td>
<td>Swiss R. Int'l</td>
<td>Shortwave Merry-go-round; 25780, 21570 (also 1536) 30-Minute Theatre; 25650, 21660, 11750</td>
</tr>
<tr>
<td>1400-1427</td>
<td>R. Sweden</td>
<td>Saturday from Stockholm; 17790</td>
</tr>
<tr>
<td>1400-1415</td>
<td>JLB</td>
<td>Nature Trail; 17890, 15115, 11740</td>
</tr>
<tr>
<td>1430-1459</td>
<td>BBC</td>
<td>Fiesta; 25650, 21760, 21660, 15400, 11750</td>
</tr>
<tr>
<td>1459-1529</td>
<td>BBC</td>
<td>Week &amp; Africa; 21590</td>
</tr>
<tr>
<td>1535-1545</td>
<td>R. RSA</td>
<td>DX Corner; 25790, 21535</td>
</tr>
<tr>
<td>1555-1559</td>
<td>CBC No. Service</td>
<td>Royal Canadian Air Force; 11720, 9625</td>
</tr>
<tr>
<td>1649-1659</td>
<td>AFRTS</td>
<td>Science Editor; 15430, 15330, 11805 (also 1949)</td>
</tr>
<tr>
<td>1714-1743</td>
<td>BBC</td>
<td>Week &amp; Africa; 21470</td>
</tr>
<tr>
<td>1807-1859</td>
<td>R. Canada Int'l</td>
<td>Canada Week; Canada a la Carte; 17820, 15260</td>
</tr>
<tr>
<td>2030-2114</td>
<td>BBC</td>
<td>Features; 15260, 15070, 12095</td>
</tr>
<tr>
<td>2130-2159</td>
<td>R. Canada Int'l</td>
<td>Shortwave Listeners' Digest; 17875, 17820, 15255, 15150, 11945</td>
</tr>
<tr>
<td>2230-2229</td>
<td>BBC</td>
<td>From Our Own Correspondent; 15260, 15070, 12095, 9410</td>
</tr>
<tr>
<td>2230-2239</td>
<td>BBC</td>
<td>New Ideas; (as above)</td>
</tr>
<tr>
<td>2315-2329</td>
<td>BBC</td>
<td>Letterbox; 15260, 15070, 9590, 9410, 7325, 6175, 6120, 5975</td>
</tr>
<tr>
<td>2330-2359</td>
<td>BBC</td>
<td>Meridian; (as above)</td>
</tr>
</tbody>
</table>

**Editors Note:**

120 Computers & Electronics

AmericanRadioHistory.Com
<table>
<thead>
<tr>
<th>MONDAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0005-0035 R. Japan</td>
</tr>
<tr>
<td>Hullo America; 21610, 17825 (also 0150)</td>
</tr>
<tr>
<td>0100-0028 Kol Yisrael</td>
</tr>
<tr>
<td>Calling All Listeners; DX Corner; 15585, 11640, 9815 (also 0210)</td>
</tr>
<tr>
<td>0105-0030 R. Moscow</td>
</tr>
<tr>
<td>Moscow Mailbag; 9600 (also 0215)</td>
</tr>
<tr>
<td>0105-0030 VOA</td>
</tr>
<tr>
<td>Critic’s Choice; 17730, 17640, 15205, 9650, 6130, 5995</td>
</tr>
<tr>
<td>0105-0055 R. Peking</td>
</tr>
<tr>
<td>Music Album; China Anthology; Letterbox; 17855, 17680, 15120 (also</td>
</tr>
<tr>
<td>0115, 0215, 0315, 0415)</td>
</tr>
<tr>
<td>0300-0115 BRT, Belgium</td>
</tr>
<tr>
<td>BRT, Belgium</td>
</tr>
<tr>
<td>0405-0055 Spanish Foreign R.</td>
</tr>
<tr>
<td>DX Program; 11880, 9330 (also 0145 and 0815)</td>
</tr>
<tr>
<td>0100-0145 BBC</td>
</tr>
<tr>
<td>Features; 15260, 15070, 11335, 9410, 7325, 6175, 6120, 5975</td>
</tr>
<tr>
<td>0106-0128 R. Canada Int’l</td>
</tr>
<tr>
<td>Shortwave Listeners’ Digest; 5960, 11850 (also 0406)</td>
</tr>
<tr>
<td>0130-0150 R. Australia</td>
</tr>
<tr>
<td>Concert Hall; 21740</td>
</tr>
<tr>
<td>0131-0156 Austrian R.</td>
</tr>
<tr>
<td>Letter from Austria; Profile; Postbox; 9770, 5945</td>
</tr>
<tr>
<td>0135-0159 AFRTS</td>
</tr>
<tr>
<td>Face the Nation; 21570, 6030 (also 0635)</td>
</tr>
<tr>
<td>0150-0213 Swiss R. Int’n</td>
</tr>
<tr>
<td>Various monthly features; 15305, 11715, 9725, 6135 (also 0435)</td>
</tr>
<tr>
<td>0200-0257 R. Nacional, Brazil</td>
</tr>
<tr>
<td>Sunday Special; 17630, 15200</td>
</tr>
<tr>
<td>0210-0228 R. Canada Int’n</td>
</tr>
<tr>
<td>Mailbag 5960 (also 0310)</td>
</tr>
<tr>
<td>0230-0300 VOA</td>
</tr>
<tr>
<td>Studio One; 17730, 15205, 9650, 6130, 5995</td>
</tr>
<tr>
<td>0230-0320 R. Netherland</td>
</tr>
<tr>
<td>The Happy Station; 9590, 6165 (also 0530)</td>
</tr>
<tr>
<td>0239-0244 R. Australia</td>
</tr>
<tr>
<td>Australian Perspective; 21740, 17795</td>
</tr>
<tr>
<td>0308-0328 R. Budapest</td>
</tr>
<tr>
<td>Various features; 11910, 9835, 9585</td>
</tr>
<tr>
<td>0330-0345 R. Australia</td>
</tr>
<tr>
<td>Spectrum; 17795 (first, third, fifth Sundays)</td>
</tr>
<tr>
<td>0330-0359 BBC</td>
</tr>
<tr>
<td>Anything Goes; 9410, 6175, 5975</td>
</tr>
<tr>
<td>0331-0356 Austrian R.</td>
</tr>
<tr>
<td>Letter from Austria; Profile; Postbox; 9770, 5945</td>
</tr>
<tr>
<td>0335-0369 AFRTS</td>
</tr>
<tr>
<td>Meet the Press; 21570, 6030</td>
</tr>
<tr>
<td>0340-0428 R. Budapest</td>
</tr>
<tr>
<td>Hungarian History; 9190, 9835, 9585</td>
</tr>
<tr>
<td>0431-0449 Austrian R.</td>
</tr>
<tr>
<td>Letter from Austria; Shortwave Panorama; 12015</td>
</tr>
<tr>
<td>0535-0559 AFRTS</td>
</tr>
<tr>
<td>This Week with David Brinkley 6000 (also 1035)</td>
</tr>
<tr>
<td>0630-0659 BBC</td>
</tr>
<tr>
<td>Man, Myth and Music; 15070, 9150, 6175</td>
</tr>
<tr>
<td>0730-0750 R. Australia</td>
</tr>
<tr>
<td>Concert Hall; 11775, 9570</td>
</tr>
<tr>
<td>0830-0859 BBC</td>
</tr>
<tr>
<td>Anything Goes; 15070, 11955, 9510</td>
</tr>
<tr>
<td>1000-1015 HCJB</td>
</tr>
<tr>
<td>Musica del Ecuador; 11925, 9745, 6130</td>
</tr>
<tr>
<td>1040-1050 R. Korea</td>
</tr>
<tr>
<td>Pageant of the Past; 25650, 21710, 21680, 11750, 9510</td>
</tr>
<tr>
<td>1130-1159 BBC</td>
</tr>
<tr>
<td>Voices of Finland; 15400, 21475 (also 1310, 1410)</td>
</tr>
<tr>
<td>1210-1229 R. Finland</td>
</tr>
<tr>
<td>1211-1226 R. Moscow</td>
</tr>
<tr>
<td>Science &amp; Engineering; 9800</td>
</tr>
<tr>
<td>1215-1244 BBC</td>
</tr>
<tr>
<td>Quiz program; 21710, 21660, 11775, 11750, 9510</td>
</tr>
<tr>
<td>1234-1256 Austrian R.</td>
</tr>
<tr>
<td>Profile of Austria; Post Box; 21535</td>
</tr>
<tr>
<td>1240-1250 R. Australia</td>
</tr>
<tr>
<td>Australian Perspective; 9580, 5995</td>
</tr>
<tr>
<td>1315-1340 R. Japan</td>
</tr>
<tr>
<td>DX Corner; Crossroads; 9505, 11815 Documentaries; 21710, 21660, 15070, 11750</td>
</tr>
<tr>
<td>1345-1414 BBC</td>
</tr>
<tr>
<td>Steven Freygood’s Shortwave Report; 11720, 9625</td>
</tr>
<tr>
<td>1415-1427 CBC No. Service</td>
</tr>
<tr>
<td>London Sinfonietta; 15260, 15070, 12095, 9410</td>
</tr>
<tr>
<td>2130-2159 BBC</td>
</tr>
<tr>
<td>DX Party Line; 21477.5, 17860, 15340</td>
</tr>
<tr>
<td>2130-2200 HCJB</td>
</tr>
<tr>
<td>Quiz Program; 15260, 9590, 8410, 7325, 6175, 6120, 5975</td>
</tr>
<tr>
<td>2330-2359 BBC</td>
</tr>
</tbody>
</table>

(To be continued next month.)
PROJECT OF THE MONTH

Making Your Own Pressure-Sensitive Resistors
By Forrest M. Mims

The conductive plastic foam that provides anti-static protection for MOS transistors and integrated circuits can be used to make pressure-sensitive resistors. The resistance of these do-it-yourself components can range from several tens of kilohms (no pressure) to a few hundred ohms or less (maximum pressure.)

Figure 1 shows just one of many possible ways to assemble a conductive-foam, pressure-sensitive resistor. The basic resistor is simply a sandwich made by placing copper foil conductors on either end of a conductive-foam cylinder or block. If you prefer, you can add embellishments (such as a plunger and return spring) to enhance the utility of the basic pressure-sensitive resistor.

The resistor can have a diameter ranging from that of a pencil eraser to a silver dollar. Copper foil for making the end contacts is available from hobby and craft shops. If you can’t find the foil, an acceptable substitute is unetched, copper-clad circuit board. In both cases, the copper should be buffed with a pencil eraser to prepare it for soldering. When the surface is shiny (both sides if you use foil), solder a length of wrapping or small-diameter hookup wire to each end terminal.

Conductive plastic foam is available from many sources. If you don’t happen to have any, try requesting a small piece from an electronics supplier or a firm or university that purchases integrated circuits in volume. Conductive foam and copper foil can be cut with scissors or a hobby knife.

You can make a miniature pressure-sensitive resistor by using a 1/4" mechanical paper punch to cut identical circles of foil and a cylinder of conductive foam. After soldering leads to the foil disks, insert a copper-foam-copper sandwich into a short section of miniature plastic tube like those in which points for lettering pens are sold. Two tiny apertures should be drilled in the side of the tube to provide exit ports for the leads. If you prefer a larger pressure-sensitive resistor, use a sawed-off section of a plastic pill bottle and proportionally larger sections of copper and plastic.

Applications for Pressure-Sensitive Resistors. Many applications exist for pressure-sensitive resistors. One possibility is a pressure-sensitive control that functions as a single-axis joystick. Another is a programmable sensor for a weight-sensitive scale. Still another is a simple accelerometer. In this role, a small weight such as a steel nut or lead fishing sinker attached to the upper, moving contact of the pressure-sensitive resistor would provide the necessary mass.

I’ve devised two simple circuits that illustrate how to use pressure-sensitive resistors in these and other applications. In Fig. 2, the pressure-sensitive resistor is connected as the variable time-constant component in a 555-astable-oscillator audio-tone generator. As the pressure on the resistor is increased, its resistance is decreased. This increases the circuit’s frequency of oscillation. While this circuit was devised merely to illustrate the use of a pressure-sensitive resistor in a straightforward analog or linear mode, it suggests possible applications in electronic music.

Figure 3 shows how a comparator can be connected to a pressure-sensitive resistor to provide a programmable two-state output. In operation, the switching threshold of the comparator is set by the variable-adjust potentiometer R3. Pressure applied to R1 lowers its resistance, thus increasing the voltage applied to the comparator’s noninverting input. When this voltage exceeds the reference voltage determined by R3, the comparator output swings to near the positive supply voltage. This turns on Q1 and illuminates LED1.

The circuit in Fig. 3 has practical applications as an input stage to a pressure-sensing logic circuit or microcomputer. Resistor R3 permits the circuit to be adjusted over a range of sensitivities.

Going Further. Conductive-foam, pressure-sensitive resistors are not as sophisticated as commercial pressure-sensing devices, but they are remarkably cheap and very easy to make. If you would like more information on the subject, Thomas Henry of Transonic Laboratories wrote a brief article entitled “Conductive Foam Forms Reliable Pressure Sensor” In Electronics magazine (May 19, 1982, p. 161).
## Microprocessor Components

### Microprocessor Chips

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>7805</td>
<td>7805</td>
<td>$1.39</td>
</tr>
<tr>
<td>7812</td>
<td>7812</td>
<td>$2.95</td>
</tr>
<tr>
<td>7815</td>
<td>7815</td>
<td>$3.95</td>
</tr>
<tr>
<td>7818</td>
<td>7818</td>
<td>$4.95</td>
</tr>
<tr>
<td>7829</td>
<td>7829</td>
<td>$5.95</td>
</tr>
<tr>
<td>7831</td>
<td>7831</td>
<td>$6.95</td>
</tr>
<tr>
<td>7835</td>
<td>7835</td>
<td>$7.95</td>
</tr>
<tr>
<td>7836</td>
<td>7836</td>
<td>$8.95</td>
</tr>
</tbody>
</table>

### Dynamic RAMs

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>6264</td>
<td>6264</td>
<td>$2.95</td>
</tr>
<tr>
<td>62128</td>
<td>62128</td>
<td>$5.95</td>
</tr>
<tr>
<td>62256</td>
<td>62256</td>
<td>$8.95</td>
</tr>
<tr>
<td>62512</td>
<td>62512</td>
<td>$11.95</td>
</tr>
<tr>
<td>62100</td>
<td>62100</td>
<td>$14.95</td>
</tr>
</tbody>
</table>

### Static RAMs

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2114</td>
<td>2114</td>
<td>$1.95</td>
</tr>
<tr>
<td>2124</td>
<td>2124</td>
<td>$2.95</td>
</tr>
<tr>
<td>2132</td>
<td>2132</td>
<td>$3.95</td>
</tr>
<tr>
<td>2142</td>
<td>2142</td>
<td>$4.95</td>
</tr>
<tr>
<td>2172</td>
<td>2172</td>
<td>$5.95</td>
</tr>
<tr>
<td>2182</td>
<td>2182</td>
<td>$6.95</td>
</tr>
<tr>
<td>2192</td>
<td>2192</td>
<td>$7.95</td>
</tr>
</tbody>
</table>

## Connectors

### DB25 - D Subminiature (meets RS232)

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB25P</td>
<td>25 Pin Plug</td>
<td>$1.50</td>
</tr>
<tr>
<td>DB25F</td>
<td>25 Pin F Jack</td>
<td>$2.50</td>
</tr>
</tbody>
</table>

### Solder Eyelid/Wire Wrap Edge Card

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>P251</td>
<td>25 Pin Solder Eyelid</td>
<td>$1.25</td>
</tr>
<tr>
<td>P252</td>
<td>25 Pin Wire Wrap Edge Card</td>
<td>$2.25</td>
</tr>
</tbody>
</table>

## IC Sockets

### Low Profile (Tin) Sockets

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>6200</td>
<td>6200</td>
<td>$1.39</td>
</tr>
<tr>
<td>6201</td>
<td>6201</td>
<td>$1.79</td>
</tr>
<tr>
<td>6202</td>
<td>6202</td>
<td>$2.19</td>
</tr>
</tbody>
</table>

### Wire Wrap (Gold) Sockets

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>6280</td>
<td>6280</td>
<td>$2.95</td>
</tr>
<tr>
<td>6281</td>
<td>6281</td>
<td>$3.95</td>
</tr>
<tr>
<td>6282</td>
<td>6282</td>
<td>$4.95</td>
</tr>
</tbody>
</table>

## Capacitor Corner

### 50 Volt Ceramic Disc Capacitors

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>100K</td>
<td>100K</td>
<td>$1.95</td>
</tr>
<tr>
<td>100K</td>
<td>100K</td>
<td>$1.95</td>
</tr>
<tr>
<td>100K</td>
<td>100K</td>
<td>$1.95</td>
</tr>
</tbody>
</table>

### MINI Aluminum Electrolytic Capacitors

- Value: 470uF (16V)
- Price: $0.95

**Contact for Quantity Discounts**

**NEW!** Technical Tips & Tricks

**Call for Current Discounts**

**With All Electronic Components!**

1355 Shoreway Road, Belmont, CA 94002

**Phone Orders Welcome!**

(415) 592-8097

**11/8/2**

AmericanRadioHistory.com
The J6E00 Hexadecimal Encoder Kit provides two separate hexadecimal dials which may be used independently or simultaneously. The dials are designed for use in conjunction with the J6E10 ASCII Encoder Kit and the J6E16 ASCII Encoder Kit. Each dial is a 16-position encoder with a rotating dial and an indicator for each position. The encoders are not interdependent and may be used separately or together.

The J6E10 ASCII Encoder Kit is designed to be interfaced into most any computer system. The kit comes complete with everything necessary to connect to a computer, including interface cables, a 16-position encoder, and a 12-digit display. The encoder is easy to use and provides a simple way to enter data into a computer system.

The J215 Adjustable Dual Power Supply provides a separate adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current requirements. The power supply can also be used as a general all-purpose variable power supply.

The HP Display Safe-National 5082 Series — 0.43 Inch — 7 Segment is a highly reliable display with a rugged design. The display is designed for use in harsh environments and is suitable for military and industrial applications.

The Jameco Electronics 8 Floppy Disk Drive is designed for use in disk drives for desktop computers. The drive is a 5.25-inch form factor drive and is compatible with 8-inch floppy diskettes. The drive has a built-in ultra high-speed data transfer rate, allowing for quick data access and retrieval.

The DE-4 UV-EPROM Eraser is a high-quality eraser designed for erasing UV-EPROMs. It is a compact and easy-to-use device that can quickly erase UV-EPROMs with minimal wear on the eraser head.

The OREGON Regulated Power Supplies from Oregen's open construction (SOC) power supplies are series regular units that are designed to provide DC voltages at 5 levels (200 volts). These units are open-frame on sturdy black anodized aluminum for excellent mounting. Each unit is a single high-precision, low-noise, single-phase AC-to-DC converter. All specifications and specifications for each unit are included in the data book. Each unit is also a 50/60Hz 14W Wt. power supply unit. The unit is a 50/60Hz 14W Wt. power supply unit. The unit is a 50/60Hz 14W Wt. power supply unit.

The Wall Transformers AC and DC Types are designed for use with various electronic devices. These transformers are available in a variety of power ratings and can be used for both 50/60Hz 14W Wt. power supplies. The transformers are highly efficient and provide stable power outputs.

The Jameco Electronics 1552-065 Key Switches are designed for use in various electronic applications. The switches are available in a variety of configurations and are suitable for use in industrial, commercial, and residential environments.
Prices Slashed!

ORDER TOLL FREE
800-538-5000
800-662-6279
(CALIFORNIA RESIDENTS)

VISA

LED DISPLAYS

IC SOCKETS

CONNECTORS

DIP SWITCHES

LINEAR

VOLTAGE REGULATORS

TRANSISTORS DIODES

LED LAMPS
ONE MAN CRT FACTORY. T.V.'s, Business machines, Monitors, Scopes, VDT's. $3.00 rebuiding rnts $100-$500 each. Write for profit overseas. Newfused. FACTORY, 1909 Louise, Crystal Lake, IL 60014. (815) 459-0666.

LCD WATCH $2.50. Pen watch $3.60. Catalogue $1.00: RE-
L IANT ENGINEERING COMPANY, Box 33616, Shuangwan Post Office, Hong Kong.

$25,000—INTEREST FREE!! Keep indefi-
nitely! FREE re-
port. Write: American, 1601 Main Street, Pleasantville, Indiana 46776.

MAKE MONEY SELLING ELECTRONICS. Wholesale dealer catalog $5 (redeemable) ETCO, Dept. 532, Box 840, Champlin, N.Y. 12919.

BORROW $25,000 "OVERNIGHT." Any purpose, Keep indefi-
nitely! Contact: American, 807 Franklin Ave., Brooklyn, NY 11208.

HUGE PROFITS POSSIBLE selling how to Make Money books by Mail. Amazing opportunity Act Now! Details $10.00. D.E.M. Sales, P.O. Box 588, Sullivan, IN 57178-8001.

FOR INVENTORS!
IDEAS HAVE VALUE!
Even 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 idea disclosure registration and initial consultation regarding your invention's potential value. Call or write for delay free help for your free information package.

AMERICAN INVENTORS CORPORATION 99 Interstate Drive, Dept. PE. West Springfield, MA 01089 (413) 737-5766

A Fee Based Marketing Company Offices Coast to Coast


EMPLOYMENT OPPORTUNITIES
ELECTRONICS/AVIONICS EMPLOYMENT OPPORT-

JOBS OVERSEAS - Big money fast. $20,000 to $50,000 plus per year. Call 716-842-6000, ext. 327.

HOBBIES

PROJECTION TV. Make $$$'s assembling Projectors. Easy.... Results comparable to $500 projectors. Your total cash less than $197.00—PLATES IN BEAVERS IN- 
VENTION $15.00. illustrated information FREE. Mac-
rocconn, Washington Crossing, Pennsylvania 18977. Cred-
itar credit 24 hours. 215-756-2889.

FULL LINE ALL PARTS & COMPUTER PRODUCTS
P.O. Box 4430C
Santa Clara, CA 95054
Will calls: 2322 Walsh Ave. (408) 988-1640

INTEGRATED CIRCUITS
Phone orders only (800) 538-8196

Computer Cash
101 Exciting, new spare-time home businesses. $3.50. RESEARCH, Box 22485, Houston, TX 77027.

LCD PENWATCHES $2.50. Calculators $4.50, Clocks $4.35. Also, C. Stereo & Speakers. NOVA, 209 Valient St., San Jose, CA 95119. (408) 281-0253.

ATARI REPAIR BUSINESS: Start your own. Send $5 for more information to: IATRA RCPIARS, 2562 E. Guadalupe, Mesa, Arizona 85204.

PROJECTIN TV... Make $$$'s assembling Projectors.

INTERDUCING A BRAND NEW MICROCOMPUTER
VENTURE is a single board computer that is an advance for the hobbyist. It is a learning training computer and is as easy to plan f for anyone who wants to get into a state-of-the-art computer at rea-
sonable cost. Venture comes in kit form or fully assembled and comes complete with your instruction manual. Please send or call toll free 1-800-502-6020. In Arizona, 1-800-652-0486. Expansion Options available. Details FREE.

Minimum Venture System $195.00 KIt includes CPU and controller and has 1K of RAM, 1K of scratchpad, 2K monochrome, 1920 video graphics, circuit interface, address and memory再加上6502-based microcomputer, keyboard, floppy, 3,100 disk. Expansion can be expanded to fill all memory. $75.00. Send for further details.

RCA Cosmic 1802 Super Elif Computer Kit $106.00

The Super Elif is a tremendous value as it combines video, digital displays, digital displays, and much more all on a single board for $106.00. The Super Elif expansion capability is virtually unlimited and you can use it inexpen-

Freely on any interface. It includes cassette interface, additional memory, color video, Basic, ASCII keyboard, printer, floppy, 3,100 disk. RS232 etc.

The Super Elif comes complete with power supply and detailed 127 page instruction manual which includes over 40 pages of software, in-

cluded in the Software Suite 10. The Software Suite includes a complete library of software that can be used in conjunction with the Super Elif. There are many software libraries available at low prices. Free 14 Page Brochure.

Send or call for brochure on details and pricing of the Super Elif and the Expansion System.

Elf II Adapter Kit $24.95

PRM Eraser
assembled 25 PROM capacity $37.50 (with FREE至今 $55.00)

GEE11, Box 1456, St. Louis, MO 63104.

Records & Tapes
Records—Tapes! Discounts to 73%. All labels. no pur-
chase obligations, newsletter, discount dividend certificates! 100% returner's credit. Free details. Discount Music Club, 65 Main St., PO Box 2000, Dept. 5-1182, New Rochelle, NY 10801.

MUSICAL INSTRUMENTS
MUSICAL INSTRUMENTS! HOT LINEn!! Incredible sales. Amps, PA gear. All instruments. Great selection Sam Ash, established 1924. 800-645-3515, NYS (212) 347-7757.

REAL ESTATE
FREE CATALOG! Top real estate values coast to coast! Specify types, property and location desired. UNITED FARM AGENCY, 612-E West 47th, Kansas City, MO 64112.

RUBBER STAMPS
RUBBER STAMPS, BUSINESS CARDS. Free catalog 1-800-851-4945, Jackson's, E-100, Brownsville Rd., Mt. Ver-
non, IN 47456.

MICROSOFT
MGP INCREASED! Bypass Pollution Devices easily RE-
VERSIBLE! Free details—Poseco GEE11, LaGrangville, NY 12540.

FREE PROMOTIONAL ALBUMS, concert tickets, stereo, etc. Information BARRY PUBLICATIONS, 477 82nd Street, Brooklyn, NY 11209.


ELECTRONIC CATALOGS
CONSUMER ELECTRONICS CATALOG—$3 cash or money order. Dealers only. $3 credit allowed on first $100. Order & B. & W DISTRIBUTORS, PO. Box 1456, St. Louis, MO 63104.

TERMS: $5.00 min. order. U.S. Funds. Calif. residents add 6% tax. $10.00 min. Visa and Mastercard accepted. $1.00 insurance optional. Shipping: Add $5; orders under $25.00—10%. Prices subject to change.

FREE: Send for our copy of our 1982 QUEST CATALOG. Include 8c stamp.

CIRCLE NO. 55 ON FREE INFORMATION CARD

Computers & Electronics
DISCOVER THE GREAT INDOORS! START A PROJECT WITH LOW-COST PARTS FROM RADIO SHACK

Neon Panel Lamps

219

Varactor UHF-TV Tuner & TV RF Modulator

A 24.95 NEW!

17.5 x 4.5mm Dia. 

B 9.95 NEW!

Engineer's Notebook II

249

Built-in resistors for 120V use.

12V Panel Lamps

Pkg. of 2

B 277-708

Ceramic IF Filters

Low As

A 99c

B 95

NOW! NEW! NEW!

Pkg. of 2

C 277-729

276-335...

NOW! Single-Supply EPROM

6.95

NOW! NEW! 199 NEW!

A Two-Section Grid Board. Each section has 750 contact points, indexed with letters and numbers on both sides—really speeds wiring, and reduces errors .100 x 100 centers for DIP ICs, sockets and headers. 276-161 .2.95

B ICL/SSI Board. Ideal for projects using ICL ICs to 40 pins. 750 contact points, Indexed on both sides. DIP centers. 276-162 .1.95

295 NEW! 199 NEW!

A Rf for AC-Line Gremlins MOV Transient Protector

NEW!

EM/U(RF Filter

119

B 273-065

C 212-197

PC-Mount Piezo Buzzers

17.5 x 4.5mm Dia. 

NEW! 2.49

A 172-1147

B 3.69

Strobe Tube & Support Parts

12V7A

NOW! NEW!

A 3.14

B 5.95

Phono Plug to Mini-Phone Jack Signal Reducer. 40 dB attenuation lets you take from line-level auxxudle output of stereo systems directly to mike input of portable cassette recorders—without distortion! 274-300 .1.99

Eight-Position DIP Switch

OFF

Only 1.99

Radio Shack

A DIVISION OF TANDY CORPORATION • OVER 8500 LOCATIONS IN 80 COUNTRIES

Retail prices may vary at individual stores and dealers

November 1982
Computer Mart

ATTENTION HP-41 OWNERS!
Need more ports for your Extended Memory, Timer, HP-IL or ROMS? The AME DESIGN PORT-X-TENDER is your answer! Expands the 41 System to 10 plug-in positions with built-in battery. No modification of calculator required. PORT-X-TENDER, carrying case and comprehensive manual included. Price: $110 add $2.50 for shipping, ad 6% in CA.

AME DESIGN
Box 373
13450 Maxella, G185
Marina del Rey, CA 90291
(213) 306-1249

CIRCLE NO. 108 ON FREE INFORMATION CARD

TR-80 DISCOUNT COMPUTERS

CALL US LAST for the LOWEST price!

918-825-4844

it will be worth the call!

AMERICAN BUSINESS COMPUTERS
118 S. MILL ST. PRYOR, OK. 74361

CIRCLE NO. 107 ON FREE INFORMATION CARD

TRS-80 Includes a FREE Green Screen, a $22.95 Value!

MODEL III 16K $789 MODEL III 48K $1898
MODEL IV 16K $289 MODEL IV 80K $649

Price — We have the best price. Check the others, but call us.

Selection — TRS-80 • APPLE • TRS-80

EPSON • OKIDATA • C. ITOH, etc.

Service — Must items in stock for immediate shipment. Call or write for Free 40 page catalog of over 600 items.

15 Marshall Hill Road
West Milford Mall, NJ
07480-2198

In New Jersey call
201-728-8080

CIRCLE NO. 110 ON FREE INFORMATION CARD

SAVE 90%

YES you can save up to 90% on a computer system of your own.

$150.00 buys a 4MHz Z80A with 64KB & a real Front Panel
$200.00 buys a Full Function 24x80 CRT with Keyboard

You can have your own computer and be running Fortran, Basic, Pascal, etc. If you get your

FREE BROCHURE TODAY

DIGATEK CORPORATION
Suite 7B
2723 West Butler Drive
Phoenix AZ 85021

ROLL-YOUR-OWN TECHNOLOGY AND SAVE A BUNDLE

CIRCLE NO. 113 ON FREE INFORMATION CARD

CIRCLE NO. 112 ON FREE INFORMATION CARD

ZX-81 Printer '13995

• Full 40 columns
• Prints library of regular
• Inverse alpha-numericics and graphics
• Print in regular and enhanced (double
• Includes mini-interface. Can be up-

CAI Instruments
PO Box 2032, Midland, MI 48640

CIRCLE NO. 109 ON FREE INFORMATION CARD

YOU CAN PAY MORE BUT YOU CAN'T GET MORE!

Color Computer 16K $305

Model III 16K $799

Model III 48K 2 disk & RS232c $1899

BUY DIRECT. These are just a few of our great

SOFTWARE

Write for free
catalog

400 King Street
Software and more.

1-800-343-8124

CIRCLE NO. 111 ON FREE INFORMATION CARD

NEW! M-68000

SINGLE BOARD COMPUTER

FEATURES:

M-68000, 8-bit CPU operating @ 8 MHz, 512K words of on board EPROM space. 3 levels of programmable interrupt. 2 memory expansion slots (or 2 in 208). 1 megabyte of 8088- or 8086-type memory expansion. 81 pin DB-260 connector. 4 RS-232C, 4 parallel-port, 2 joystick, 2 game port, 1 microphone, 1 stereo audio, 1 stereo video. Soldered 100% boards. All components are Surface Mount Technology, fully tested, guaranteed. '560' on board clock. Software compatible with MITS, TRS-80, ZX-81...

PRICE:

$399.95

FREE SHIPPING on orders over $250.00 in the US. $10.95 for your first board. Programs available for the ZX-81, TRS-80, 1200). For more information contact: E.M.S.

1-800-524-1234

CIRCLE NO. 114 ON FREE INFORMATION CARD

AmericanRadioHistory.com
51/4" Floppy Disk Drives  
(Direct IBM® Plug-in)  
TANDON Model TM 100-1 $199* ea.  
TANDON Model TM 100-2 $299* ea.  
12' Green Phosphor Zenith Monitor $109* ea.  
Also available - TM 602S, 603S, and 603E Winchester Drives  
For info or orders call - 316-683-9225 or 685-9445  
MC / VISA or C.O.D. with certified check or money order  Kansas residents add 3% sales tax.  
Plus shipping.  
G-H Computer Systems, Inc.  
923 Longfellow Street  
Wichita, Kansas 67205  

Sinclair ZX81  
Software on cassette.  

IBM - XEROX - TRS-80 - CRAY  
HEWLETT-PACKARD - NORTHSTAR  
DEC - HEATH - ZENITH - PMC  
OSBORNE - OSI - INTERTEC . . .  

WE HAVE  

IBM - XEROX - TRS-80 - CRAY  
HEWLETT-PACKARD - NORTHSTAR  
DEC - HEATH - ZENITH - PMC  
OSBORNE - OSI - INTERTEC . . .  

The CONNECTION  

Connect your IBM Selectric®, IBM Electronic, or Olivetti typewriter to any Microcomputer.  

ESCON Products, Inc.  
12919 Alcosta Blvd.  
San Ramon, Ca. 94583  
(415) 820-1256  

(800) 227-2148  

CIRCLE NO. 108 ON FREE INFORMATION CARD  

CIRCLE NO. 111 ON FREE INFORMATION CARD  

CIRCLE NO. 120 ON FREE INFORMATION CARD  

CIRCLE NO. 116 ON FREE INFORMATION CARD  

CIRCLE NO. 115 ON FREE INFORMATION CARD  

CIRCLE NO. 119 ON FREE INFORMATION CARD  

CIRCLE NO. 121 ON FREE INFORMATION CARD  

CIRCLE NO. 122 ON FREE INFORMATION CARD
Get more out of your Apple with the MICRO on the Apple Series

Vols. 1, 2, & 3 $24.95
+ $2.00 shipping each volume
Each book includes more than 30 programs — all on DISKETTE

Machine Language Aids
I/O Enhancements
Runtime Utilities
Graphics & Games
Hardware & Reference
Information
To order toll free: 1-800-345-8112
In PA 1-800-662-2444
MICRO INK, Dept. PE
P.O. Box 6502
Chelmsford, MA 01824

DISKETTES
Cassettes
Error-Free 5¼-inch Diskettes (MD-5) single-sided, soft sector, single or double density, reinforced hub.

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty 10</th>
<th>Qty 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD-5</td>
<td>$25.00</td>
<td>$110.00</td>
</tr>
<tr>
<td>C-10</td>
<td>$7.50</td>
<td>$32.50</td>
</tr>
<tr>
<td>C-20</td>
<td>9.00</td>
<td></td>
</tr>
<tr>
<td>C-60</td>
<td>11.50</td>
<td>50.00</td>
</tr>
<tr>
<td>C-90</td>
<td>15.00</td>
<td>70.00</td>
</tr>
</tbody>
</table>

UPS SHIPPING INCLUDED in Continental USA
CA Customers included taxes

MICROSETTE
475 Ellis St., Mt. View, CA 94043 (415) 968-1604

CIRCLE NO. 124 ON FREE INFORMATION CARD

VIC-20 INTERFACING BLUE BOOK
Did you know that you VIC can be used to control a 966 toy motor so effectively that it
runs like a precision machine? Or that you can build an accurate digital thermometer using the
VIC and four parts costing less than $50?

Projects Include: Connecting VIC to your ears; Pac-Man, Pick-up, digital look, capacitance
meters; Liquid level sensor; Telephone dialer; voice output; BR/BRAM expansion, 28K RAM expansion; 8-bit precision O/A, 8-bit
A/D converter, MX-80 Interface and more.

Written by a college professor in a friendly and informative style, the Blue Book gives you
theory of operation, schematics, program listings, parts list, construction hints and sources of material for each one of the 20 projects.

If you want to get the most out of your VIC book is a must! Cost is $14.95 less than
the price per project! Price includes postage.

MICROGINAL
Dept B
900 El Camino Del Mar, Unit A
Goleta, CA 93117

VIC-20

CIRCLE NO. 130 ON FREE INFORMATION CARD

UV EPROM ERASER

$49.95

WHY TILLER & SAFETY SWITCH

MICROSTATION

INDUSTRIAL MODEL

58.95

FREE IN USA

FREE SHIPPING

FEATURES:

Locate Eprom bugs in minutes
Accepts all common Eproms
Convenient size ("1/2" x 3" x 1 1/4"
Ideal for field service or laboratory
Very economical

$149.95 plus Postage & Handling

MARTEC SYSTEMS INC.
Box 2069
Newburgh, NY 12550
(914) 265-4044

CIRCLE NO. 125 ON FREE INFORMATION CARD

CIRCLE NO. 126 ON FREE INFORMATION CARD

GOING OUR WAY?

Quality Software for Apple II and Apple /// Computers

For free literature write to:

COMPUTER SERVICE
Viotech Data Center
P.O. Box 650 - Joshua Tree, CA 92282

For further information call (714) 355-6568.

CIRCLE NO. 127 ON FREE INFORMATION CARD

CIRCLE NO. 128 ON FREE INFORMATION CARD

CIRCLE NO. 129 ON FREE INFORMATION CARD

CIRCLE NO. 131 ON FREE INFORMATION CARD

AmericanRadioHistory.com
CONTROL THE WORLD!
A/D conversion, high current outputs, switch closure and logic inputs, BASIC language, RS-232 and cassette interfaces, and EPROM programmer are only some of the features of this family of single board computers. The lowest cost unit can control more than 2000 external devices. Programmed learning text, software, and other support available. Industrial, educational, and home uses. Prices start below $150.
Octagon Systems Corporation
5150 West 80th Avenue Suite B
Westminster, CO 80020
(303) 426-9780

RADIO SHACK
TRS-80's™
We offer Special Discounts, Free Shipping and a Toll Free Order Number!
1-800-531-7466 TOLL FREE
Pan American Electronics
Dept. P.E. - 1117 Conway Avenue
Mission, Texas 78572
(512) 581-2766 Telex 767339

OUR PRICES
HAVE NEVER
BEEN LOWER!

Call COLLECT to Order!
(805) 484-8146
QUALITY DATA SUPPLY
P.O. Box 238, Camarillo, CA 93011
Authorized Distributor
information Processing Products

3M
Scotch diskettes
A brand you can trust!
Reliable and dependable!

SPARTAN Electronics Inc.
CALL (516) 640-8500
6052 Jericho Tpke.
Commack, N.Y. 11725

Remote T.V. Converter
139.95 Ea. 4 & up $125.00
50 Channel Wireless Control

FREE SOFTWARE 6 PAK
When you purchase a VIC 20 8K Exp
$5.00 16K Exp $11.00

40 Channel VHF to UHF Block Converter
$29.95 Ea. 24.95 4 & up

Volume Discounts
(See MC, BAC, Amex, Check, COD, Money Order)
Free for shipping

Visa, Master Card, Amex, Check

SCB ELECTRONICS CENTER
5103 Lincoln Ave., Cypress, CA 90630

FREE INFORMATION CARD

SUPER SALE

EPROM's
2716 (5V 450nS) $3.95
2732 (5V 450nS) 7.49 CALL
2532 (5V 450nS) 8.49 CALL
2764 (5V 300nS) 19.95 CALL

STATIC RAM
6116P-3 (150nS) 6.50 6.30 CALL
2114L-2 (200nS) 2.10 1.70 CALL

DYNAMIC RAM
4164-2 (200nS) 7.90 7.49 CALL
(1580nS also available) CALL

MISC
CPU 280A $5.29 EA.
CVP-1854ACCU $4.80 ea.
16K RAM Expansion Kit for TRS-80 Mod III $12.95

SUNTRONICS CO., INC.
12621 CRENSHAW BOULEVARD
HAWTHORNE, CALIFORNIA 90250
STORE HOURS: Mon. to Friday 10:00 am to 6:00 pm, Sat. 9:00 am to 5:00 pm, Sun. Closed.
(213) 644-1149 1-800-421-5775

CIRCLE NO. 113 ON FREE INFORMATION CARD

CIRCLE NO. 114 ON FREE INFORMATION CARD

CIRCLE NO. 115 ON FREE INFORMATION CARD

TRS-80 COMPUTERS

Model II 64k $3286
Model III 64k $925
Model III 48k 2 Drives RS232 $1295
Color Computer 4k Level I $306
Color Computer 16k Extended Basic $459

EPSON Printers $CALL

Discounts
Allow full return within 14 days

Texas Computer Systems
P.O. Box 1327
Arlington, Texas 76004-1327
TOLL FREE 800-433-5184

Texas Residences 817-875-5625
PAYMENT: Money order, cashier's check or certified check. Prices reflect 5% cash discount. Call for Visa and Mastercard prices.

CIRCLE NO. 139 ON FREE INFORMATION CARD

CIRCLE NO. 140 ON FREE INFORMATION CARD

CIRCLE NO. 137 ON FREE INFORMATION CARD

CIRCLE NO. 136 ON FREE INFORMATION CARD

CIRCLE NO. 138 ON FREE INFORMATION CARD

CIRCLE NO. 139 ON FREE INFORMATION CARD

CIRCLE NO. 139 ON FREE INFORMATION CARD

CIRCLE NO. 139 ON FREE INFORMATION CARD
SATELLITE TELEVISION • HOWARD'S COLEMAN boards to build your own receiver. For more information write... ROBERT COLEMAN, Rl. 3, Box 56-APE, Travelers Rest, S.C. 29690.

GUARDIANS OF THE UNTAMED • Free catalog. Call our order line 1-800-650-0722 or write for our latest brochure.}

STOP! DON'T PAY EXTRA! Buy our high gain 2-2.5 GHz Microwave Television Down Converter kit with temperature stabilization and power supply (less transformer) for $45. Down Converter board and parts, only $28.25. GUARANTEED! Send payment to: HOPTRONIX, Box 401392, Garland, TX 75040.

ACOUSTIC TEST SET for adjusting equalizers, speakers; $449. Free Brochure. HALL ENGINEERING, Dept. 22, P.O. Box 506, Martinsville, N.J. 08843.

ACOUSTIC TEST SET for adjusting equalizers, speakers; $449. Free Brochure. HALL ENGINEERING, Dept. 22, P.O. Box 506, Martinsville, N.J. 08843.

ESSENTIAL SURPLUS • For all your surplus test equipment needs! Free catalog. Send $9.95 to U.S. buildup: ABC-STAR, Box 709, Philadelphia, Pa. 19105.


ACOUSTIC TEST SET for adjusting equalizers, speakers; $449. Free Brochure. HALL ENGINEERING, Dept. 22, P.O. Box 506, Martinsville, N.J. 08843.

ACOUSTIC TEST SET for adjusting equalizers, speakers; $449. Free Brochure. HALL ENGINEERING, Dept. 22, P.O. Box 506, Martinsville, N.J. 08843.

ACOUSTIC TEST SET for adjusting equalizers, speakers; $449. Free Brochure. HALL ENGINEERING, Dept. 22, P.O. Box 506, Martinsville, N.J. 08843.

ACOUSTIC TEST SET for adjusting equalizers, speakers; $449. Free Brochure. HALL ENGINEERING, Dept. 22, P.O. Box 506, Martinsville, N.J. 08843.
NEW LHIF Converters and Cable units Sound out TV CH 3 antenna connections Model A Gated Pulse Suppressed Model B Computerized Addressable, Model C Cable computerized Send 2 for information, J&D Engineering, P.O. Box 469, Boston, MA 02116. 617-837-8431.

SATellite TV Breakthrough

ONLY .18 METER (5.8 foot diameter)

Our 96 PAGE TECH BOOK REDUCED...ONLY $6.00

SPACECAST

RESEARCH CORPORATION

ALAMO SPRINGS, FL 32701

SPACEIMAGER—3 dimensional display...Explicit, technical instruction. StellarVision, 2162 Leghorn Mountain View, CA 94040.

SATELIterEQUIPMENTCatalog. Over 25 best of the manufacturers and suppliers. LNA's receivers, antennas and complete systems covered in four different sections. A satellite aiming chart and microwave interference handbook (10.00 value) included. Send $19.95 U.S., TMS Co., P.O. Box 8369, Roseville, CA 95651.

NEW PRODUCT

—ADJUSTABLE DC TRANSFORMER—

Converts any suitable DC input to an output voltage more, equal, or less than the input voltage. Limitless practical applications. Continuous overload and short circuit protected. Near zero no-load idle current—High efficiency. 10 amp $76.95 or send $2.00 for brochure and technical data sheet to: MICROSMITH INC., P.O. Box 3365, La Vale MD 21502

XMARS TRAINS...28 ggs expert advice. $2 + SSAE to: TRAINS, Box 3117, 22043.

SATELTER RECEIVER IF SWEEP GENERATOR...70 Mhz IF Sweeps 40-100 Mhz $97 Head End Systems, P.O. Box 8756, Portland, Oregon 97207.

CABLE TV BOXES & ACCESSORIES. Complete units. ModeLock available in kit form as will all aspects of Build Electronics, 2961 Industrial Rd., Dept. 199 NE, Las Vegas, NV 89109.

MICROWAVE TELEVISION "DOWNCONVERTERS." Exclusive new five stage design. Easily assembled. Catalogue: $2.00 (refundable), MDS, Box 124626, Dallas, 75325.

FREESPEAKERCATALOG—Thousands of speakers and antennas at the lowest prices. Free cabinet plans, plastic woofers, ribbon tweeters. Send $1.00 postage for brochure and technical data sheet to: MICROSMITH INC., P.O. Box 3365, La Vale MD 21502.

COMPUTER EQUIPMENT

SAVE 90% Build Your Own microcomputer. Free Details, Digicable, 2723 West Butler Dr. Suite 20C, Phoenix, AZ 85021. US $600.00 build 48K Apple compatible including housings, details US $1.00. Reliable, P.O. Box 33610, Sheungwan, Hong Kong.

PLUGS-INS AND AD-ONS for the IBM PERSONAL COMPUTER, availability as well as advice. Build it yourself and save. Other 8088-based products too, Free information. Compatible Computer Corp., Dept PE 5, Box 51102, Seattle 8915.


LATEST adventure, adventure...software. Free discount catalog, American Computer Works, 228 Palen Ave., Newport News, VA 23601.

ZENTHI MONITOR: Model ZVM-121, only $115.95. Free information, Tech-Systems, P.O. Box 565, Spring, Texas 77373.

LOW PRICED COMPUTER PRODUCTS, Printers, CRT's, Mainframes, Angel Computer Products, 1719 South Carmelina, Los Angeles, 90025, (213) 820-4231.

USERS Club: Sinclair ZX81. Write SSAE, Ron Hale, 15 Charles St, #27055 T, Baltimore, MD 21201.

USE COMPUTER TERMINALS, PRINTERS, MODEMS, CABLES, SURPLUS ELECTRONIC PARTS, SPECIALS: DAISY WHEEL PRINTERS (will interface to various computers) $305.00. XEROX EPS CPU BOARD (single board computer, new, assembled & tested) $495.00. CATALOG $1.00. RONDUP COMPANY, "The Computer Room" PE, 2522 BUTLER STREET, DALLAS, TX 75225. (214) 830-4601.

TELETEX 4320 KSR terminal w/modem for sale. 1981 model, like new, only used 50 hours. Make your offer: Dick (702) 831-6166, POB 6878, Incline Village, Nevada 89450.

2000 BOOKS, Software, accessories covering TRS-80; Apple; Texas Instruments; IBM, Commodore Computers. Catalog $2.00 prepaid. (Refundable on 1st order). JMC, 10256 Industrial Drive, Bensenville, Illinois 60154.

COMPUTER SOFTWARE

$6 VIC-2SO SOFTWARE arcade games too. Send stamped envelopve, videocassette, 26 Hollis St, Providence, RI 02907.

Ti-99/4A OWNERS 6 programs plus list $5.95. cash, check, M.O. PROGRAMS, 1435 Burnley Squ. N., Columbus, Ohio 43229.

10 PRINT "ZX81 DATA-SHARE" "Receive up to 100 ZX81 programs compatible with 100 units each.

"Data-Share," P.O. Box 2824, Modesto, California 95351.

SINCLAIR ZX81/TSS-100 TRS-80 COLOR COMPUTER PROGRAMS. Wide selection/high quality. Catalog $1.00. Zap Software, Box 3522, Greenville, SC 29608.

CROSS ASSEMBLERS, SIMULATORS. Written for FORTRAN for most microprocessors. IDI, 16395, Dillon, CO 80435. (303) 468-0112.

COMPUTER HARDWARE

APPLES CORE—Microphotographs of the 6552 microcomputer. Other chips also. Free brochure, i.C. Shots, 21 Witt Avenue, Dennville, NY 12724.

SUPERSALE FOR APPLE II. Disk drives $299.95, 16K Ram Board $59.95. EVETREK, Box 1311, Provo, Utah 84603, 017-373-5389.

COMPUTER PUBLICATIONS


AMATEUR RADIO

CALL US FIRST. For low Ham prices. All major brands. DISCOUNT, DISCOUNTS! Prompt Shipping. Madison Electronics, 1508 McKinney, Houston, TX 77010. Daytime: (713) 696-0268.

AMATEUR RADIO CALLBOOKS: 1983 Directories of Radio Amateurs around the world. U.S. Callbook $23.00. Foreign Callbook $22.00, shipped including. See your Dealer or write for FREE catalog. RADIO AMATEUR CALLBOOK, Dept CE, 925 Sherwood Dr., Lake Bluff, IL 60044.

C.B. EQUIPMENT

GET MORE CB CHANNELS AND RANGE! Frequency Expanders, spreak processors, PLL locks, FM converters, how-to-books, plans, modifications. Catalogue $2. CB CITY, Box 31980P, Phoenix, AZ 85046.

PLANS AND KITS

PRINTED CIRCUIT Boards from sketch or artwork. Kit projects, Free details. DANOINCHS Inc., Dept PE, Box 261, Westland, MI 48185.

GIANT SCREEN TV projection system conveys all television into 7-foot picture. Lens & instructions $14.95. (Dealers welcome). Bell Video, 4616 Balair Rd., Baltimore, MD 21206.
Start Computing With an Affordable Radio Shack TRS-80® Model III

The Complete Personal Computer That's Hard to Outgrow

The versatile and powerful TRS-80 Model III is ideal for beginning enthusiasts because it has big computer features at a remarkably affordable price—and it grows with you as your needs and expertise increase.

No Experience Necessary. You don't have to be a computer expert—just add an optional recorder and use our ready-to-run cassette software for everything from exciting games to word processing to statistical analysis. Our entertaining, step-by-step manual is included and makes BASIC programming easy to learn.

The Extras Are "Built-In." The attractive one piece cabinet contains a 12" high-resolution monitor, which displays 64 upper and lower case characters, a 65-key typewriter keyboard with datapad, and parallel printer interface.

That's Not All. You get 16K internal memory, Model III BASIC language, 500 and 1500 baud cassette operation, repeating keys, special graphics characters, program editor and real-time clock.

Expand Your Horizons. You can add up to 32K more internal memory, and one or two internal double-density disk drives (and up to two more externally). Add a printer or plotter for professional hardcopy output or an RS-232C serial board and modem for communications.

A TRS-80 To Meet Every Need. If you're ready now, complete Model III disk systems start as low as $1849.

It's Available Now. See the 16K Model III at a Radio Shack Computer Center, store or participating dealer. Stop by today and pick up your free copy of our new 1983 TRS-80 Computer Catalog—or use the coupon.

Send me your free TRS-80 Computer Catalog today!
Mail To: Radio Shack, Dept. 83-A-247
300 One Tandy Center, Fort Worth, Texas 76102

NAME
ADDRESS
CITY STATE ZIP

Retail prices may vary at individual stores and dealers.
Imagine

Never having to type the word "CATALOG." or trying to remember how to get from one part of a program to another!

If you could do these functions, and many more like them, at the STROKE of a SINGLE KEY, would you? We thought you would! So, we invented the Enhancer [ ] and the Function Strip. More than just another lower case adapter, the Enhancer [ ] is an intelligent keyboard processor. Now characters, strings of data, commands and statements can all be stored in your Enhancer [ ] for immediate recall by pressing JUST ONE KEY!

Features that you would expect only on larger systems now can be yours, EASILY! For instance, wouldn’t you like auto-repeat, and hi-speed repeat? How about a type-ahead buffer? Even user-definable function keys are available for greater input flexibility.

The Videx Enhancer [ ] and Function Strip: it really is the Dawn of a New Era for Apple [ ]

Suggested Prices

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENHANCER [ ]</td>
<td>149.00</td>
</tr>
<tr>
<td>FUNCTION STRIP</td>
<td>79.00</td>
</tr>
<tr>
<td>Package Deal</td>
<td>215.00</td>
</tr>
</tbody>
</table>

CIRCLE NO. 57 ON FREE INFORMATION CARD