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MODERN ELECTRONICS

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THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

THE BOOMING WORLD OF CONSUMER ELECTRONICS
A Special Report

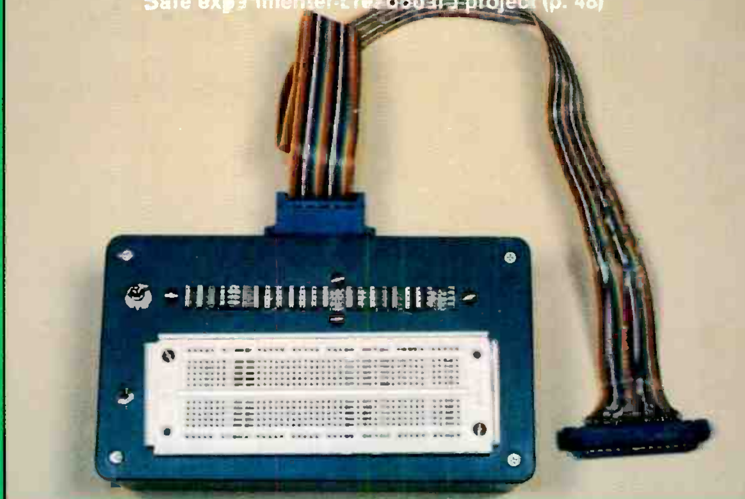
Evaluating Vidicraft's new TV commercial cutter for VCRs (p. 14)

EXPLORE COMPUTERIZED CONTROL WITH AN EXPERIMENTER'S BREADBOARD

- Testing the First Digital TV Receiver/Monitor!
- Improve Electronic Outputs with Better Rear-End Circuits
- How to Automatically Remove TV Commercials from VCRs
- Designing an EPROM Programmer—From Thinking Stage to Finish

Add a serial board to TRS-80s (p. 16)

Safe experimenter-breadboard project (p. 48)



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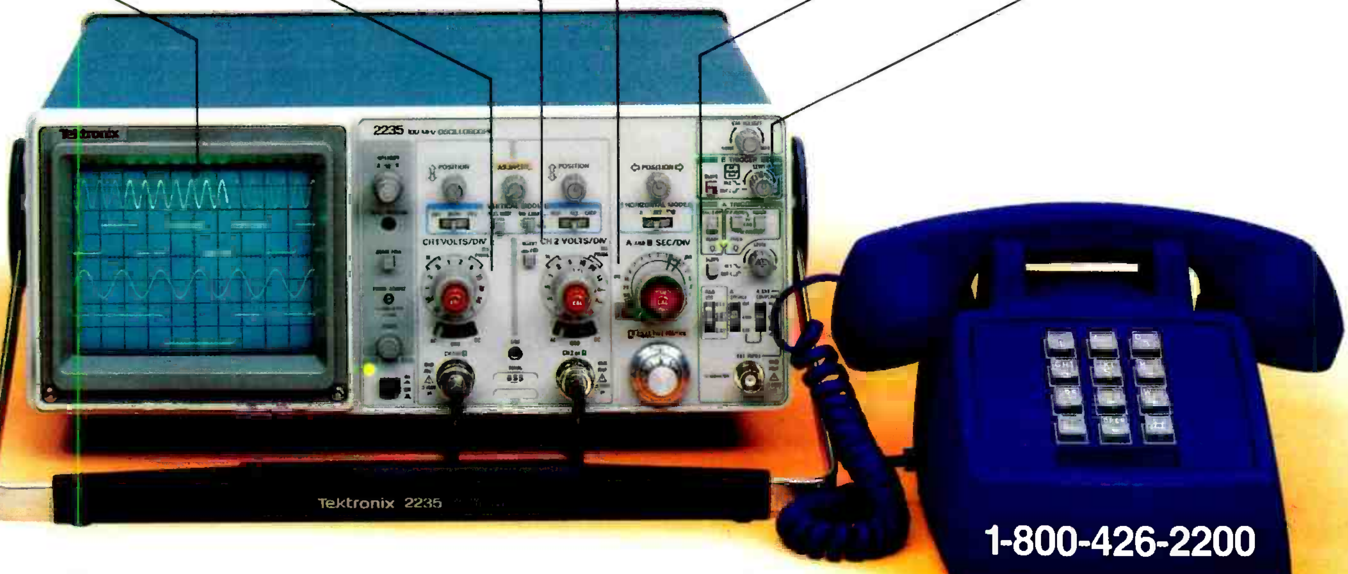

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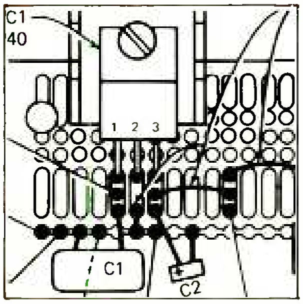

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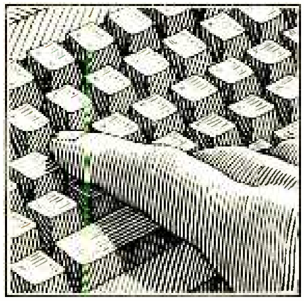

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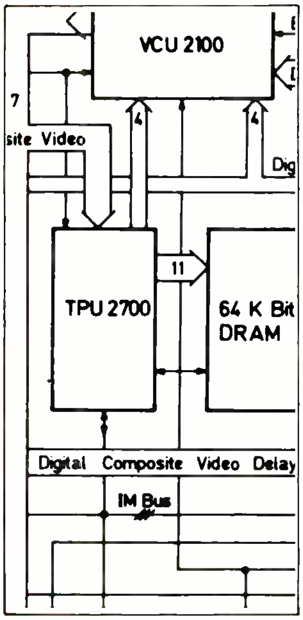

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EDITORIAL

The New Pirates

One dictionary definition of a pirate is a person who appropriates without right the work of another. Electronics/computer enthusiasts, which most of you are, have faced this in one way or another. Perhaps you bought LP records that were, unknown to you, counterfeit copies. More recently, illegal copying of computer software has been in the news. People who do this appear to be the new pirates of our electronic age.

"Computer software piracy by students and schools has become a serious social problem," said educational technologist Sherwin Steffin at a recent educator's copyright panel. Moreover, a number of lawsuits have been launched during the past year against users of mass-marketed software for illegal copying. And increasingly sophisticated copy-protection schemes have been developed to stop such piracy. Let's examine the basic "theft" problem more closely.

No one can deny that copying software without proper authorization is wrong. However, enough justifications are proferred to make it clear that the act is difficult to stop, at least for "personal" owners, as compared to corporate owners. The disk-copy functions built into all personal computers make it s-o-o easy to do. In practical terms, then, it is indeed a challenge to software makers.

The incidence of copying software is in some proportion to the price (and popularity) of the software. One might say the same thing about bread or milk. If a loaf of bread cost $100, do you think that more people would steal bread? Of course. Therefore, one way to reduce illegal software copying is to lower the price.

Now how does a software vendor establish the selling price of his product? In many instances I believe that it's based on what the market will bear. So we see software, like the ever-popular WordStar, with a $495 suggested retail price. After many years in computer life, this has been driven down by competition to around an actual selling price of $200. This apparently still leaves the retailer, wholesaler, and manufacturer a satisfactory profit. Why wasn't it more reasonably priced to begin with, which would have reduced piracy at the outset?

Along these lines, *Forbes* (January 28, 1985) reported the experiences of a software manufacturer that explored price determinants by seeking out where the price curve meets the demand curve. The company, Noumenon Corp., has an integrated software package ("Intuit") that was originally priced at $395. It didn't sell well at all, even with a full advertising program. The company then dropped the price in one fell swoop to only $50, raising it $20 each week while tracking sales. Sales were highest at $90, so the company pegged its price at $89.95, which contrasts with similar software that costs $695 (actually selling for around $350).

This isn't the end of the marketing story, of course, since increased sales is always desirable. This requires advertising and promotion expenditures to call out the program's features, establish brand recognition, and so on. And this costs money, too, that must be thrown into the price. Nonetheless, it's an interesting experiment.

Flying by the seat of your pants in pricing, however, can't be all that bad. Large businesses and governmental agencies look at features first, price sometimes last. This is especially true when you're first with the most. So sales of bloated-price software, if they have the right features, don't seem to be hurt much in this respect. But here is where some volume pirating takes place. And here is where software makers can hook the culprits more easily and where it becomes worthwhile in terms of retrieving payment. Furthermore, publicity about a legal suit always gives others a moment of pause.

Lotus Development Corp., maker of the popular Lotus 1-2-3 integrated software, sued two prominent corporations for allegedly copying their software illegally . . . and won undisclosed sums of money in a settlement. ADOPSO (Association of Data Processing Service Organizations), representing software maker interests, recently filed a copyright infringement suit against a major office supplier, charging the company with illegally copying and using a few popular programs, including WordStar.

My own feeling is that prices are often outrageously high; they should be lowered. However, software makers observe that it is increasingly costly to develop new software, which is more sophisticated nowadays, and that many software companies fail in business. This fortifies a view that software prices are not exhorbitant. Secondly, user guides (documentation or whatever you wish to call them) are notoriously inadequate. As a consequence, computer books that show how to use certain software are big sellers. Software makers should improve their manuals to induce people to buy their wares rather than copy a disk(s) and struggle along without documentation. Thirdly, I see nothing wrong with copy protecting a disk if two backups can be made before full protection takes effect. And fourth, upgraded and replacement disks, the latter an exchange for a defective master disk, should be sold at a very nominal charge.

Also, demonstration disks should be offered at very low cost since a person really doesn't know if a sophisticated software package meets his needs and could well be reluctant to spend, say, $400, for one that turns out to be undesirable. You have to spend a lot of hours with major applications packages before you know what you really have.

To stem piracy (estimated to be $325-million in 1984 revenue) a variety of copy protection schemes are used by many software makers. Some don't permit you to make any backup copies at all. If your master disk goes bad, you must send it to the manufacturer and wait for a new, good one. This has been the major justification for illegal copying issued by pirates. After all, why should his computer be shut down; he *should* have a backup copy that's being used as a working disk! So computer hackers often break the copy protection code, make an unauthorized copy that's given to a friend, who gives it to . . .

Some software manufacturers really don't care if their material is copied. They say that it spreads word about their products' attributes, and that many pirates wind up buying their program to get documentation and upgrade information.

What about morality? Ethics? There doesn't seem to be an excess of that around, it seems; there never has been. So what to do?

Whatever the solution to piracy is, it can't come soon enough since the micro software industry is losing about 25% of its revenue because of it.

Art Salsberg

LETTERS

Project Winners

• As you wrote, Heath has evolved from its airplane kits to a partnership in electronics with Zenith, other magazines haven't published a how-to-build electronics article for ages, and some current ones cost per issue what I paid for some used college textbooks! So when I saw "Digital Humidity Controller [January 1985 issue], I bought *Modern Electronics*. Neat!

Donald Bassett
Monticello, IN

Your bargraph tachometer [project] in the December issue was a real winner! Keep up the good work.

Ari Burton
(No address given)

Forget Me Not

• I sent in my check for a subscription in December. As of February 1, I haven't received anything. Have you forgotten about me?

Michael Butts
Albert Lea, MN

We haven't forgotten. It usually takes about six weeks before you get your first issue or for an address change to be made. We backstart subscribers so that they don't miss that first issue even if a little late—Ed.

30 Years Ago

• It's great to see another general electronics type magazine on the stands again. Is there any significance to the fact that exactly thirty years ago *Popular Electronics* went into circulation? In that issue there was a high tech construction article for a tube-type AM radio that straddled the handlebars of a bicycle! In your magazine there were articles on the Hero robot and the new Elf pocket color TV. That's high tech by any standards!

I did some pioneering work in liquid crystal displays back in the 1970's and can appreciate the magnitude of this accomplishment. It's tough to multiplex a display whose characteristics change greatly with temperature and from unti-to-unit. I was given one of the prototype Elf TVs to play with for a few hours last June and found it to perform as the reviewer said it did. However, this set (like any multiplexed LCD display) is very angle sensitive and must be viewed "straight on." Look at it from an angle, especially certain angles, and the colors will wash out.

Gary McClellan
La Habra, CA

• Congratulations! It's actually exciting to read a magazine from cover-to-cover again. You seem to have successfully recreated all of the enthusiasm and professionalism that *Popular Electronics* once displayed. I also notice that you introduced *Modern Electronics* on the 30th anniversary of the birth of *PE*—most appropriate.

Robert Knupp
Phoenix, AZ

The 30-year mark was just happenstance. The issue's launch month, October, wasn't. It's considered to be the beginning of the pre-Christmas period, with more new-product activity.—Ed

TVRO Sales Outlets

• Read your article on Home Satellites TVRO in the February issue and enjoyed it. We are going to install a system in the near future. Your article was very definitive in contrast to others I've read, and we thank you. On the ones you covered, can we buy from the manufacturer or do we go through a distributor?

C.B. Caldwell
Alpine, CA

Satellite TVRO equipment is sold direct from manufacturer, distributor, or through dealers (both stores and direct mail), depending on how distribution is set up for a particular brand—Ed.

More Fan Letters

• When I picked up your January issue, I thumbed through it, and before my eyes were articles by Don Lancaster, Forrest Mims, and others I enjoy. So before reading a single article, I'm sending you my subscription check.

Charles Disher, Jr.
Nappanee, IN

• My husband has been interested in electronics for many years. Not the computer machines, but the circuits. We're always looking on the magazine counters for electronics publications and were very glad to have found yours.

Mrs. Albert Daniels
Fort Atkinson, WI

COMPUTER FISHING. Microelectronics has come to the ordinary bait-casting reel. Daiwa's new PT10E reel has a built-in microcomputer, believe it or not, that enables the fisherman to program line test, line lengths, and other parameters. An LCD display shows vertical movement with depth in feet, while lure descent and ascent retrieval speed is shown; length of line out is displayed on the readout together with a graph, and an audible beep sounds every second so that you can figure out these matters in your head too. So now you can know how deep your jig was when your fish struck, and more.

AUSTIN'S MAGNET SCHOOL. The Austin (Texas) Independent School District has established an innovative school-within-a-school. Called the Academy, it focuses on science, math and computer education, starting at LBJ High School. Students will be selected according to performance on an entrance exam, personal interview, an essay, and previous accomplishments. The Science Academy program will emphasize research and applications, and feature mentorships and access to sophisticated technological equipment. IBM, which employs 7000 people in the area, has donated a scanning electron microscope to the Academy. It'll magnify objects up to 100,000 times normal size in contrast to optic microscopes that provide 2000X magnification. Dallas-based Texas Instruments, in turn, donated 20 transportable TI Professional Computers, 20 of its Model 850 printers, and assorted software.

HAMS USE PACKET SWITCHING. About 2,000 amateur radio stations use packet-switching communcations right now, employing an agreed-upon standard protocol, AX.25. Two-meter FM equipment is the favored transmission mode, which is used in conjunction with personal computers for data communications, steering satellite antennas, and other rewarding work. Old Oscar 10 satellite is used.

COMPUTER SCIENCE ACCREDITATION. Computer science course standards are being worked on by representatives of the IEEE Computer Society and the Association for Computing Machinery. The outgrowth of this effort is expected to be standards for accrediting computer programs, now offered in about 1,000 schools in the U.S.

WHAT'S IN A NAME. Names can be interesting, whether they're acronyms or changes. For example, not too many years ago a company named Kentucky Fried Computer Co. changed its name to Northstar. EDSYN, a well-known manufacturer of solder removal tools, is an acronym that stands for "Engineering Dedicated to Suit Your Needs." And the Apple Lisa model will now be called Macintosh XL, ostensibly for "extra-large" to reflect its internal hard disk and two megabytes of memory.

CAR ELECTRONICS MILESTONES. The Buick Division of GM is toying with an in-dash touch-sensitive CRT terminal for drivers to control a variety of functions. Video icons give drivers or front-seat passengers a wide choice of selections and adjustments, such as playing a radio, trip data, climate control, and others. Choosing one icon causes other icons to pop up, which might be a visual display of speaker balancing in response to touching a graphic equalizer icon. Ford and Chrysler are headed in this direction, too, with Ford expected to debut an optional model in its Continental Mark VII sometime this year.

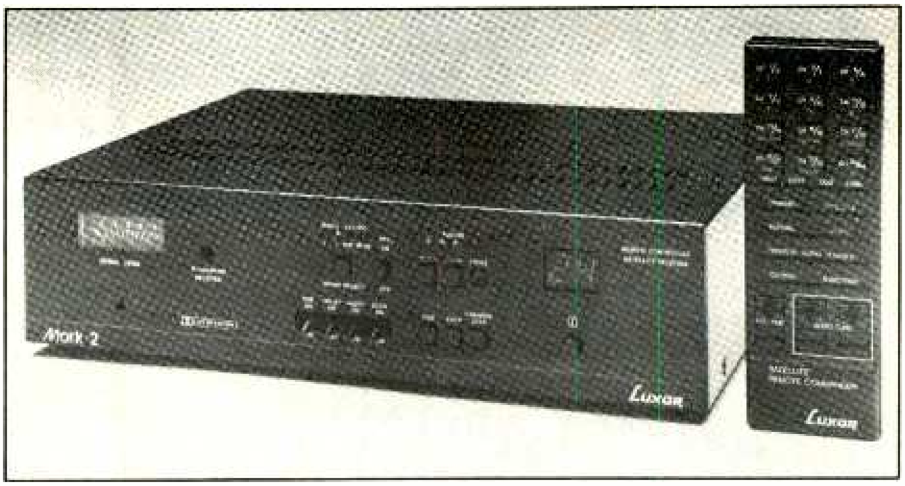
For more information on products described, please circle the appropriate number on the Free Information Card bound into this issue or write to the manufacturer.

World's Smallest Walkman

Sony has done it again! Now it offers on-the-go listeners the smallest Walkman®, a personal radio, complete with built-in rechargeable nickel-cadmium battery and recharger. The new FM-stereo Walkman, about the size of a credit card, measures just 3⅜" × 2⅛" × ⅛" thick. The Model SRF-210 radio features an electronic feather-tough volume control, high-quality Sony earphones, and automatic power-off. Its one-chip IC design is said to provide high performance with maximum reliability. An FM antenna is built into the headphone cord. $74.95.

CIRCLE 4 ON FREE INFORMATION CARD

Satellite TV Receiver



The Mark 2 remote-controlled satellite TV receiver from Luxor (North America) Corp. is designed to be the single integrated satellite component needed for the home or office. Equipped with a stereo processor and Dolby noise-reduction system, the receiver uses "block conversion" that enables several TV sets to share one satellite TV antenna with independent channel selection on each. The receiver can be preprogrammed and fully operated by the infrafed Satellite Remote Commander. If an optional antenna-positioning system is used, it can also be controlled with the hand-held remote transmitter.

A large digital channel indicator, signal-strength meter, and LED tuning indicator permit fast visual checks on receiver performance. One of four different built-in audio modes, including direct or matrix stereo, and Dolby noise reduction can be preporgrammed for automatic selection on any channel. Also provided is a narrow/wide-band audio selector for reception of all subcarrier signals. A 2-to-1 audio signal expander is provided for improved sound quality. An automatic fine-tuning circuit seeks out and maximizes the video signal for every selected channel.

CIRCLE 5 ON FREE INFORMATION CARD

Apple IIc Portable Briefcase.Power System

The Prairie Power Portable System is a nifty accessory for on-the-go Apple IIc computer owners. It is a soft briefcase with built-in battery power pack and recharger. It accommodates the computer and has a removable disk storage compartment and a separate compartment for stowing the IIc's optional Flat Panel LCD display screen when not in use. The durable Cordura briefcase also has protective PVC insert panels, a nylon wrap-around zipper, soft suede handle for comfort and a padded shoulder strap that stores inside the case when not in use.

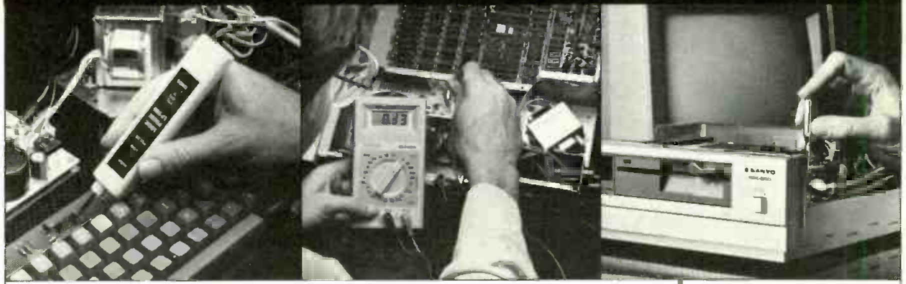
Up to eight hours of power are available from the battery pack when fully charged and powering the IIc with Flat Panel LCD screen. The power pack is equipped with an audible signaling device that sounds an

(Continued on page 12)

Train for the Fastest Growing Job Skill in America

Only NRI teaches you to service and repair all computers as you build your own 16-bit IBM-compatible micro

New from NRI—the only home study course that trains you as you assemble a top-brand computer!



After you construct this digital logic probe, you'll install the "intelligent" Sanyo detached keyboard, with its dedicated microprocessor.

You next assemble the power supply into the main unit of the computer. Using the digital multi-meter, you check all keyboard connections and circuits.

After you install the disk drive and monitor, you'll make a backup copy of the MS-DOS operating disk, explore the 8088 microchip and additional circuits.

As computers move into offices and homes by the millions, the demand for trained computer service technicians surges forward. The Department of Labor estimates that computer service jobs will actually *double* in the next ten years—a faster growth than any other occupation.

Total System Training

As an NRI student, you'll get total hands-on training as you actually build your own Sanyo MBC-550-2 computer from the keyboard up. Only a person who knows *all* the underlying fundamentals can cope with *all* the significant brands of computers. And as an NRI graduate, you'll possess the up-to-the-minute combination of theory and practical experience that will lead you to success on the job.

You learn at your own convenience, in your own home, at your own comfortable pace. Without classroom pressures, without rigid night-school schedules, without wasted time. Your own personal NRI instructor and NRI's complete technical staff will answer your questions, give you guidance and special help whenever you may need it.

The Exciting Sanyo MBC-550-2—Yours To Keep

Critics hail the new Sanyo as the "most intriguing" of all the IBM-PC compatible computers. It uses the same 8088 microprocessor as the IBM-PC and the MS/DOS operating system. So, you'll be able to choose thousands of off-the-shelf software programs to run on your completed Sanyo.

As you build the Sanyo from the keyboard up, you'll perform demonstrations and experiments that will give you a total mastery of computer operations and servicing techniques. You'll do programming in BASIC language. You'll prepare interfaces for peripherals such as printers and joysticks. Using utility programs, you'll check out 8088 functioning. NRI's easy step-by-step instructions will guide you all the way right into one of today's fastest growing fields as a computer

service technician. And the entire system, including all the bundled software and extensive data manuals, is yours to keep as part of your training.

Your NRI Course Includes a Sanyo MBC-550-2 Computer with 128K RAM, Monitor, Disk Drive, and "Intelligent" Keyboard; The NRI Discovery Lab®, Teaching Circuit Design and Operations; a Digital Multimeter; Bundled Spread Sheet and Word Processing Software Worth $1500 at Retail—and More.

How the pro computer critics rate the Sanyo 550:

"Sanyo BASIC is definitely superior to IBM Microsoft . . . lets you use two or three keystrokes for entering BASIC commands."

—MICROCOMPUTING Magazine

". . . compares favorably with the IBM PC, even surpassing it in computational speed . . ."

—COMPUTERS & ELECTRONICS Magazine

"I went to have a look at the MBC-550 . . . what I found made me an owner the next day!"

—Bill Sudbrink, BYTE Magazine

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NEW PRODUCTS ...

(from page 7)

alert before available power drops below acceptable levels. It also has LEDs that indicate when the battery is being charged and when charging is complete.

When completely outfitted with an Apple IIc computer, the system weighs less than 20 lbs. Dimensions are 17″W × 13½″H × 5″D. Its $269.95 price includes case, battery pack and charger, wall transformer, disk pouch, shoulder strap and all necessary cables.

CIRCLE 6 ON FREE INFORMATION CARD

Diminutive DMM

Beckman Industrial's new Model DM10 is a true pocket-size digital multimeter. This newest addition to the company's Circuitmate line is only about the size of a pocket calculator and weighs a mere 4.5 ounces. It is easy to operate, too, thanks to its single rotary function/range switch and 3½-decade liquid-crystal display with ½″-high numerals. The DMM offers five functions in all, including the capability of measuring ac and dc voltages, dc current and resistance and the ability to test diode (and transistor junction) condition.

There are five dc ranges that permit measurements to 200 mV, 2 V, 20 V, 200 V and 1000 V full-scale, with overload to 500 V ac and dc on all ranges and to 1000 V dc on all ranges above 200 mV. Two ac ranges allow measurements to 200 or 500 V full-scale, with overload protection to 500 V ac and dc. Current can be measured to 200 μA, 2 mA, 20 mA and 200 mA full-sclae (dc only), all protected by a 0.8-A/250-V fuse. There are also five resistance ranges that go to 200, 2K, 20K, 200K and 2000K ohms, with overload protection to 250 V ac and dc. $39.95.

CIRCLE 7 ON FREE INFORMATION CARD

Full Programmable Compact Disc Player

Technics' Model SL-P3 compact disc player brings music listening into a new realm of sophistication. If offers 15-step programmability and a multifunction wireless remote control. For convenience, a unique Disc Prism on the illuminated motor-driven disc drawer reflects an image forward to let you see if a disc has been loaded. Ten numeric and one MEMORY keys permit you to choose tracks in any random order, or directly access selections by track or index number. You can repeat the entire disc or programmed selections or, by using an A-B Repeat function, instantly repeat any one selection during play.

Automatic music scan lets you preview the first few seconds (selectable from 1 to 99) of each track. Auto Pause makes the player pause at the beginning of each selection, while Auto Cue puts the player in standby at the beginning of each selection for instant start at the touch of a button—a handy feature when dubbing to tape. Up/down scan-type level control keys are teamed with an LED level indicator.

A large fluorescent display panel provides a 15-bar indicator that charts play by blinking the appropriate segment as each track is being played. This panel also displays track and index numbers, as well as total playing time and time remaining in minutes and seconds. Indicators are also provided for the repeat function, A-B Repeat, Music Scan, 15-track overrun, and disc compartment open. $600.

CIRCLE 16 ON FREE INFORMATION CARD

Deluxe Car Stereo

Jensen's new top-of-the-line Model RE980 in-dash AM/FM-stereo radio/cassette player packs a lot of features into a small package. Leading off is a quartz-controlled PLL synthesized tuner with six AM and FM station presets plus continuous-scan bidirectional station selector (with 5-second sampling on each station) and a local/distant switch. There are separate BALANCE and FADER controls for the 10-watt audio amplifier section. Also provided are an automatic power an-

RE980 ELECTRONICALLY TUNED RECEIVER

tenna control lead and a sensor lead that automatically turns on external amplifiers and equalizers when the RE980 is switched on. The tape player offers a super-hard permalloy head, an illuminated tape slot for easy cassette loading at night, and locking fast-forward and rewind functions. A back-lit liquid-crystal display (LCD) panel provides readouts of tuned frequency, time of day, station preset number selected, and tape play.

Among the deluxe features you will find is a Dynamic Noise Reduction (DNR) system that reduces background noise on AM and FM broadcasts as well as hiss on cassette tapes. An Automatic Tape Search (ATS) feature automatically advances the tape to the beginning of the next selection or returns it to the beginning of the current selection to begin play. $299.95.

CIRCLE 18 ON FREE INFORMATION CARD

Outdoor Scanner Antenna

Butternut Electronics' new Model SC-3000 scanner antenna is a vertical colinear array designed for outdoor mounting. It is designed to provide reception on the hf (30-to-50-MHz), vhf (108-to-174-MHz) and uhf (440-to-512-MHz) bands. The sophisticated "gain" antenna is claimed to pull in weak signals not normally heard when using typical outdoor scanner antennas, using patented "Trombone" phasing sections that are said to provide up to 7 dB more gain than can be obtained with a ½-wave vertical antenna.

The 11-ft. antenna has more capture area than most scanner antennas. It uses sturdy aluminum tubing construction with stainless-steel hardware. It is rated to survive up to 100-mph winds. The antenna is terminated in an SO-239 connector and will accept the standard PL-259 coaxial male plug. $65.

CIRCLE 19 ON FREE INFORMATION CARD

Laboratory-Quality Frequency Counter

A lab-quality frequency counter with a specified range from 5 Hz to 1 GHz has been announced by VIZ Test Equipment. The new Model WD-756 counter offers eight decades of LED display in which leading zeros are blanked, plus discrete annunicator LEDs. A switchable low-pass filter allows the user to include or reject low-frequency components (between 5 Hz and 10 MHz) of high-frequency signals. Additional features include: a rotary-type RANGE switch; dual inputs with front-panel selector switch; a switchable attenuator that prevents overloads by reducing high-amplitude signals to one-tenth; and a shielded metal chassis to reduce emi and rfi. The circuit is designed around CMOS, TTL, low-power Schottky TTL, and LSI devices. The instrument measures 11"W × 8¾"D × 3⅝"H and weighs 3.5 lbs. $399.

CIRCLE 22 ON FREE INFORMATION CARD

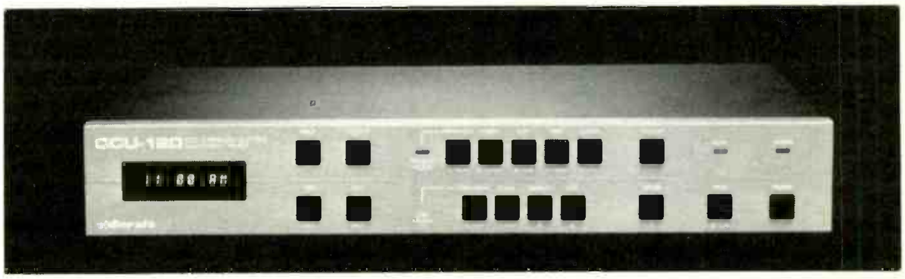
Motion-Detector Switch

A low-cost device that provides automatic switching upon detection of motion has been introduced by Microwave Sensors, Inc., 7885 Jackson Ave., Ann Arbor, MI 48103, for use in convenience, security, and energy-management applications. The Mod-

(Continued on page 89)

Video

Automatically Kill Commercials:
Vidicraft's CCU-120 Commercial Cutter/Event Timer



Psst! Wanna get rid of all those commercials that normally clutter up the TV programs you record on video tape? Want more mileage from each and every videocassette you use for recording TV programs? If you think satisfying these cravings is only an unrealizeable dream, you haven't heard of Vidicraft's Model CCU-120 commercial cutter and event timer. Representing a technological breakthrough, the Vidicraft CommCutter (as we'll call it here), is a dual-microprocessor-controlled electronic accessory that almost magically wipes out commercials and restores to you the tape they normally consume. It also provides a sophisticated events timer for at least 12 events up to nine weeks in advance, with repeats daily, weekly, or weekdays only.

By removing commercials during the recording process, the CommCutter makes it possible for an 8-hour VHS or a 5-hour Beta cassette to capture the equivalent of 10½ or 6½ hours, respectively, of commercial TV time. Vidicraft claims that the CommCutter is 98% effective on entertainment programs and about 90% effective with talk-only programs like newcasts. Though the system isn't infallible (you do occasionally lose a bit of program along with the commercials), it goes a long way toward alleviating the irritations of having to skip past recorded commercials and allows you to recover tape time normally lost to them.

Designed to work with the slowest Beta III and VHS SLP tape speeds of infrared wireless remote-controlled VCRs, the CommCutter currently supports only top-of-the-line models (see box). Other IR-controlled models, with more mundane capabilities, will likely be added to the list of VCRs supported by the accessory in the near future.

Housed inside a low-silhouette black cabinet, the CommCutter presents an appealing blue brushed-aluminum front panel on which are arranged square black control/programming buttons, red LED indicators, and an 8-character alphanumeric fluorescent time/program display. Its suggested retail price of $399.95 (as much as you might spend for an economy model VCR these days) may appear to be steep, but when you consider what the CommCutter does, you'll soon realize that it's reasonably priced . . . if you can afford the luxury it offers.

How It Kills Commercials

The CommCutter is no ordinary "commercial killer" that merely activates and deactivates a VCR's pause function at the onset and conclusion of a commercial. It actually records all commercials along with the desired program, analyzes what it's recording to determine whether or not there is a commercial, then backs up to the beginning of the commercial segment (using the VCR's rewind function), and resumes recording over the recorded commercial(s) with the next segment of the desired program.

To accomplish what it does, the CommCutter employs two Z80 microprocessors, the same as those used in many popular 8-bit personal computers. Backing up the microprocessors are four EPROMs that contain the routines required to make things happen when and how you want them to occur without having to key in a long series of computer-like programming steps, and a RAM that temporarily stores your programming choices in memory. (EPROM and RAM are acronyms for erasable programmable read-only memory and random-access memory.)

One of the Z80 microprocessors handles timing, programming, and video monitoring. The other executes the first processor's commands, based on your instructions in RAM, and operates the infrared signal that controls the VCR's operation.

When used with an appropriate IR-controlled VCR, the CommCutter siezes control of the deck's operating controls in much the same manner as the wireless remote transmitter that comes with the VCR does. In other words, it selectively activates the record and rewind/review functions as needed to delete commercials. The sequence is as follows.

The VCR starts up in the normal manner in the record mode. (It can be started up manually or in the preprogrammed timed function.) During the whole time the recording is in progress, the CommCutter's circuitry is continuously monitoring and sampling both the audio and the video outputs from your VCR. Transitions, the so-called "fades-to-black" that occur between scenes in a program or between program and commercial or spot announcement, are identified by the CommCutter, which then analyzes a number of factors to determine whether or not the segment that follows is a commercial. Meanwhile, recording proceeds.

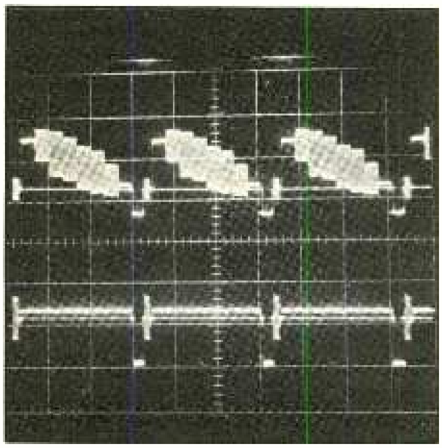
Having determined that a segment is indeed a commercial by using its sophisticated battery of analyses, the CommCutter backscans the tape to the beginning of the segment. It then switches the VCR back into the record mode and continues recording and analyzing. It will repeat this procedure for each and every commercial, station break, and spot announcement until all have been deleted. Since there are almost always more than one commercial and/or announcement stacked one after the other at every break, the backscan/ record operations may be repeated an equal number of times before deletions are complete.

From the foregoing, it's obvious that there's going to be a slight delay between the onset of the backscan function and resumption of recording. Consequently, there may be some loss in the program before the record function resumes. The amount of program loss depends on the speed of the backscan/record operation. The length of time lost depends on the segments to be deleted from the tape and the specific VCR being used. For the typical 30-second commercial, the loss amounts to 9 to 12 seconds, while for the less-frequent 2-minute commercial it would be 14 to 22 seconds. Beta machines generally execute the backscan/record operation faster than do VHS machines and, therefore, have less time lost on return to program.

Cited loss times are for programs that resume immediately following fade-to-black after the final commercial. Of course, with programs like mini-series that have identification tags, the loss time will be reduced or eliminated altogether.

On occasion, the CommCutter might mistake a portion of program for a commercial and delete it. However, accidental program deletions are claimed by Vidicraft to occur only about once in every 50 hours of recording. Furthermore, such occurrences average less than 60 seconds per incident. Finally, program losses due to both accidental deletion and return-to-program delay are claimed to average less than 60 seconds per recording hour.

Programmed as a "thinking machine," the CommCutter will purposely overshoot the start of any initial commercial



The CCU-120's lab test scope photo shows color bars as composite video with the blackburst in lower trace.

by a few extra seconds to be sure of sufficient coverage and then use this as a tape measure to zero in on the others. Should you make a programming error, the equipment will politely tell you about it. It may also wipe out film or program credits that appear to be commercials. End-of-tape automatic rewinds may also result in a minute or two of rerecording, but this condition seldom occurs.

It should be obvious why the CommCutter requires at least one microprocessor to unattendly perform as it does to remove commercials. The combination of commercial cutter and timed recording capabilities makes this a very attractive addition indeed to any home video system in which a videocassette recorder plays a prominent part.

Setting It Up

Integrating the CommCutter into an existing video system is the easy part. It consists basically of plugging in cables between your VCR and the CommCutter, plugging in and fastening in place the latter's infrared emitter, and plugging in the ac line cord. This gets you ready for the harder part—programming the CommCutter.

All connections from the CommCutter are made through clearly labeled jacks located on its rear panel. Included here are video input and output jacks, separate right and left pairs of audio input and output jacks, and the jack into which you plug the IR receptor.

Coaxial cables are first connected between your VCR's video and audio outputs and the mating inputs of the CommCutter. There are two audio cables for stereo operation. Only one cable is used in monophonic audio setups; it goes to the left mono channel on the rear of the CommCutter (the right channel is left open in this case). Next, the IR emitter cord is plugged into its connector on the rear of the CommCutter. After this, you peel away the paper that covers the emitter's adhesive surface and carefully attach the emitter to the VCR's IR receptor window, taking care not to block the usual signal path for the VCR's remote-control transmitter. After plugging the CommCutter's line cord into an ac receptacle, you're ready to begin programming the accessory.

Now comes the hard part.

Programming The Thinking Machine

Learning to program the CommCutter, like learning to use a VCR, is best accomplished by using the equipment, exercising each of its sophisticated functions and features. The "thinking machine" offers lots of help along the way. If you really goof, there's a numbered table (the Help Message Table) on page 19 of the manual that accompanies the CommCutter that will relatively painlessly extricate you from just about any difficulty imaginable that results from misprogramming. And if all else fails, you can pick up the telephone and give Vidicraft a buzz.

With your VCR connected to an outdoor antenna or cable-TV link, with appropriate input to your TV receiver, set up for operation on channel 3 or 4 and you're ready to program the CommCutter. Before proceeding, however, you must disable any VCR lockout channel scheme. The CommCutter then takes over timing, command and commercial excising operations, with your VCR acting as a TV signal receptor and recorder and operating as a slave to another VCR or fresh signals directly off the air.

You start programming by pushing the CommCutter's TIMER button, followed by pressing of the DAILY or WEEKDAYS buttons for daily or weekly unattended recording. Next, you key in the day of the week start and stop times and program length and whether or not you want to automatically cut commercials from your recording(s). A CLEAR button permits reprogramming in the event you make a mistake.

Here's an example of the programming sequence. If the SELECT MODE LED is lit, you press the PROGRAM button, call for daymode (at which point the DAYMODE LED lights), and you choose daily or weekly recordings. The daily mode records the same channel at the same time every day, the weekdays mode records the same channel and time Monday through

Friday, and the weekly mode records the same channel and time on the same day of every week. Finally, there's a day mode that records only once on a day indicated. An ENTER button is then pressed to store your selections in the CommCutter's RAM memory bank and the day and time are set. While you're doing this, the CommCutter asks you where to start, program length in minutes, stop time, channel, and whether or not to cut commercials.

In effect, you have much the same scheme with the CommCutter as you have with a programmable calculator. But everything is logically in step, using "user-friendly" plain English prompts along the way with the CommCutter. Should you overlap two programs during the programming operation, the fluorescent display will politely inform you that a conflict exists.

When you've programmed the entire routine into the CommCutter, you have a final crack at correcting or adding to what you've done. The CommCutter asks REVIEW, CANCEL, MORE (the question mark is implied) in its display window. If all answers are NO, the display returns to standard time of day, the SELECT MODE LED lights, and all events that have been programmed into memory are awaiting final countdown to automatically activate at the correct time and on the correct day. All you have to do at this point is sit back and enjoy the action.

Some of the back and forth gyrations that occur during the record operation may appear to be strange, and to someone who doesn't know what the CommCutter is designed to do, as an equipment malfunction. On playback, you won't notice anything amiss. Actually, you'll really be astonished at the smoothness of this interesting accessory's operation.

VCR Compatibility List

At this writing, just a few of the many infrared wireless remote-controlled VCRs on the market can be controlled by the Vidicraft Model CCU-120 commercial cutter and event timer. Most or all are top-of-the-line models. Below are listed the currently supported VCRs. By the time you read this, though, more manufacturer names and models are almost certain to be added, perhaps even a few widely distributed less sophisticated models with more mundane features.

Manufacturer	Models
Canon	VR-40/VT50
GE	ICVD4020X
Hitachi	VT5P, VT19A, VT34A, VT35A
Magnavox	VR8440
Panasonic	PV1720, PV1730, PV1780, PV6600
Quasar	VH5435, VH5747
RCA	VGT650, VJP900, VKP900, VKT550, VKT945, VKT950
Sony	SL2000, SL2700, SL2710

Playback quality depends largely on the signal-to-noise (S/N) ratio, horizontal frequency response and operating condition of your videocassette recorder and the quality of the tape on which a recording has been made. If the picture quality in the long-play mode of your VCR is lousy to begin with, don't expect any improvement in quality on playback, since the CommCutter doesn't provide any signal processing. The S/N of most modern VCRs should be reasonable in any play mode, which is the strong point of this equipment. But high-frequency response will probably not exceed 2 to 2.5 MHz at best, which is their weak point.

The Bottom Line

Knowing how a new product like the Vidicraft Model CCU-120 commercial cutter and event timer works usually satisfies partial curiosity. Seeing the results usually does the rest.

A great deal of work has gone into both the design and programming of Vidicraft's CommCutter. It does what Vidicraft claims and executes well in both timing and erasure procedures. The 12-event, 9-week programming capability of the CommCutter may be of considerable interest to many VCR owners if and when newer, less-flexible VCRs are added to the product's compatibility list. Vidicraft has announced that reprogramming updates will be made available to accommodate future videocassette recorders.

You may be wondering if the TV broadcast studios can defeat a product like the CommCutter. The answer is yes, simply by adding some luminance and color to the black program-to-commercial transition period. But the broadcasters aren't likely to act on this until products like the CommCutter become too numerous for them to dismiss. And they won't until the price drops substantially. For now, the Model CCU-120 has center court and has easily won the first round.—*Stan Prentiss*

CIRCLE NO. 159 ON FREE INFORMATION CARD

Computers

CompuLogic RS-232 Interface Modification For TRS-80s

If you have a Radio Shack Model III or 4 that was orginally a cassette-based unit, it probably has had an RS-232 serial interface added. Perhaps, you've finally decided to join the world of telecommunications between computers, and you now need to have the RS-232 interface for operation with a modem. Or maybe you have a serial device (such as a printer) and need a serial interface to drive that device. For whatever reason, when you finally decide you can't live without an RS-232

interface any longer, you'll discover that Radio Shack sells one for $100 plus installation—but only if you haven't modified your TRS-80 in any way!

There are other alternatives. You could build your own RS-232 interface, though you'd better know what you're doing! You could buy a parallel-to-serial converter "black box" for about $100—and lose the use of your parallel port for your printer. Or you could get a product such as CompuLogic's "RS-232 Serial Interface Modification Kit" for less than $70.

I took the latter path in order to use a Model III cassette-based system for telecommunications applications. My machine had two non-Radio Shack disk drives, disk controller and drive power supply added by a local non-Radio Shack dealer, causing local Radio Shack stores to balk at installing their RS-232 serial port add-on. That's when I remembered seeing CompuLogic's mail order ad that stated "non-technical people will find that installation is quick, straightforward and simple, requiring less than 15 minutes to complete." Figuring I could spare 15 minutes, I ordered their RS-232 interface board. It came quickly.

CompuLogic's Kit

Though the word "kit" is used, the board is completely assembled. It measures 4½" × 7". It is electronically and physically a direct replacement for Radio Shack's RS-232 board and is totally compatible with Radio Shack's hardware and software. The board uses 16 integrated-circuit chips, and has a standard serial female DB-25 connector at one end. Baud rates range from 50 to 19,200, and word length, parity and stop bits are under program control. The board may be used in either half-or full-duplex operation.

Installation, however, does require disassembly of the computer cabinet. The board mounts inside the Model III or 4 on existing brackets; illustrated, detailed step-by-step mounting instructions are included, together with three cables and four screws. No soldering is needed.

Installation of this interface will void your Radio Shack 90-day warranty, so if your computer is still within warranty you may want to wait until the warranty peeriod has expired. The CompuLogic board itself is guaranteed for a full year.

Nerve and Guts

My computer was well beyond the guarantee period, and I intended to install the RS-232 board myself. However, after reading the -instructions (which took more than 15 minutes right there!) I decided I didn't have the "nerve and guts" referred to in the Parts Checklist. I knew I had non-Radio Shack parts inside by Model III, and had a horrible feeling something wouldn't mate properly, so I'd better let an expert do it. I was right!

CompuLogic's instructions are detailed enough if you have a pure Radio Shack unit. There is a clear illustration of the physical mounting area and the four pre-threaded spacers the board mounts to with the screws provided. There's another illustration showing the layout of the longest of the three cables, and how to put a "Z" bend in it. The instructions include 16 numbered paragraphs, in small print. What made me hesitate, however, was that there were no schematic and no interface cabling or connector pin information. As it turned out, this would have been helpful, so I'm including some of this information in Fig. 1.

Installation

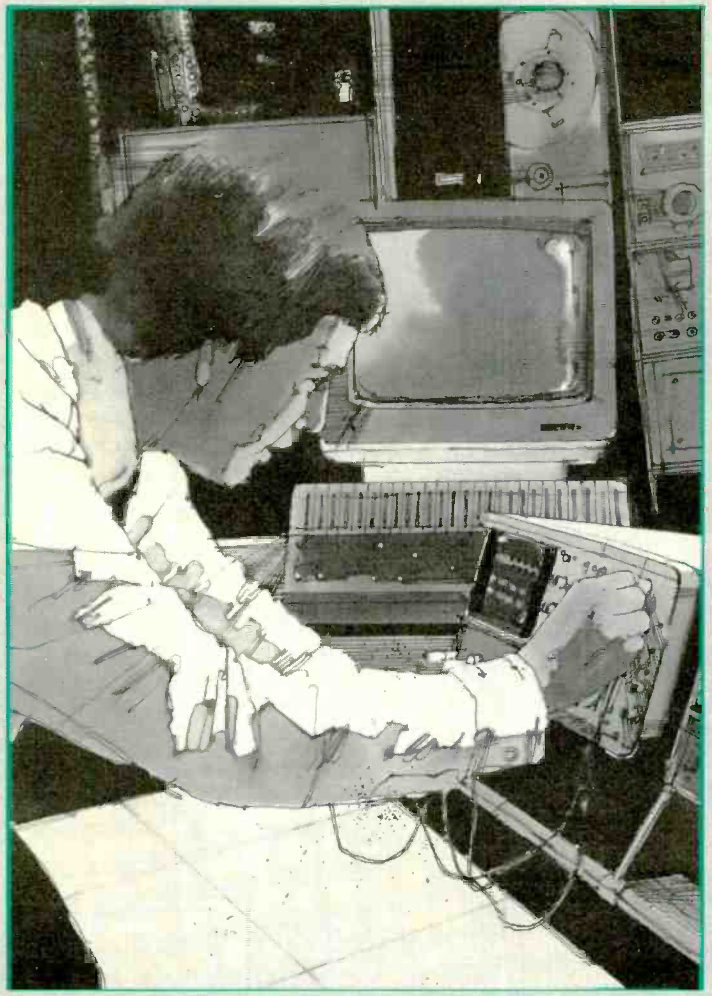
I made arrangements for Dan Strizich, Independent Technical Service (Canoga Park, CA), one of the few people around here willing to poke around the inside of a TRS-80, to install the CompuLogic interface for me. He estimated about an hour's work for $30. I brought the Model III over to his shop.

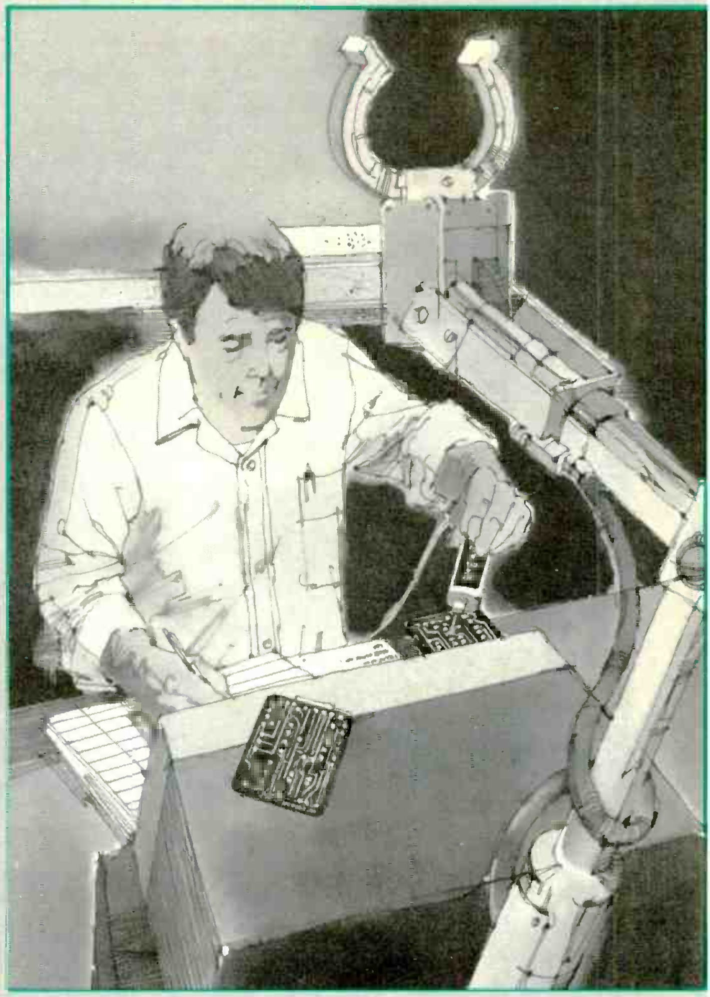
Following the instructions, Dan removed the screws holding the TRS-80 Model III together and got the cabinet to separate. He carefully lifted the top of the case, including the CRT, straight up until it cleared the back, then put it on its side and disconnected the cable to the main cabinet. That safely put aside, he turned the computer so the back faced him and (gasp!) disconnected the various cables.

He removed a large metal panel covering the main CPU board and then *removed the entire board,* just like the instructions said.

There were the four pre-threaded spacers, just like the instructions' illustration. Dan screwed the interface board to those spacers, with the DB-25 connector facing downward. Then he plugged one end of a dc Power Cabled (supplied) to connector P3 on the new board, with "the red wire

(Continued on page 94)





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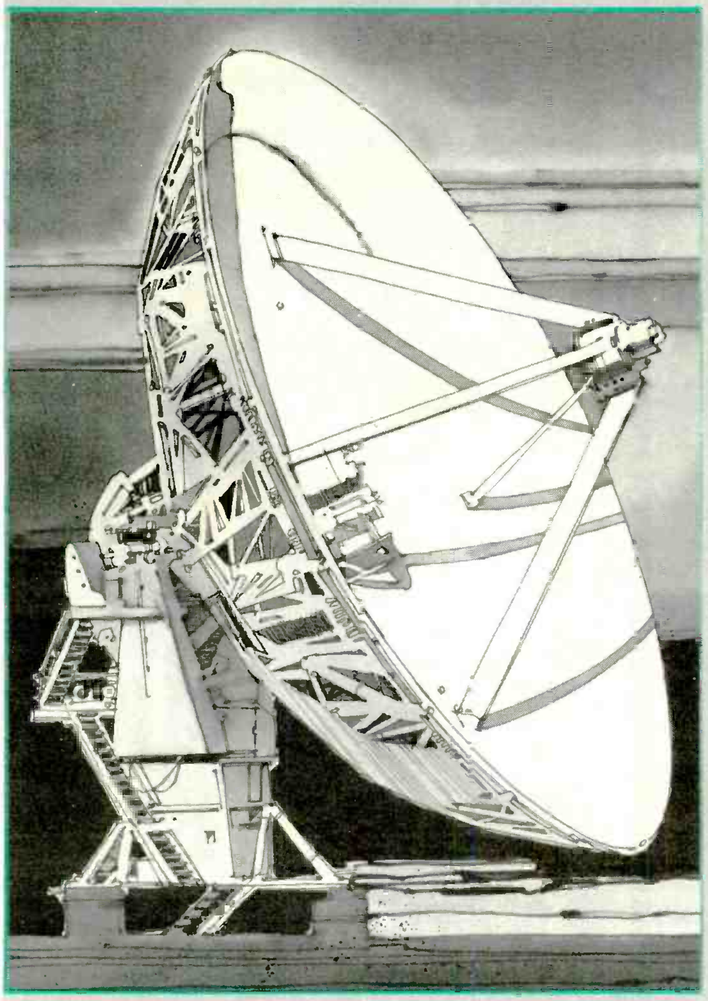

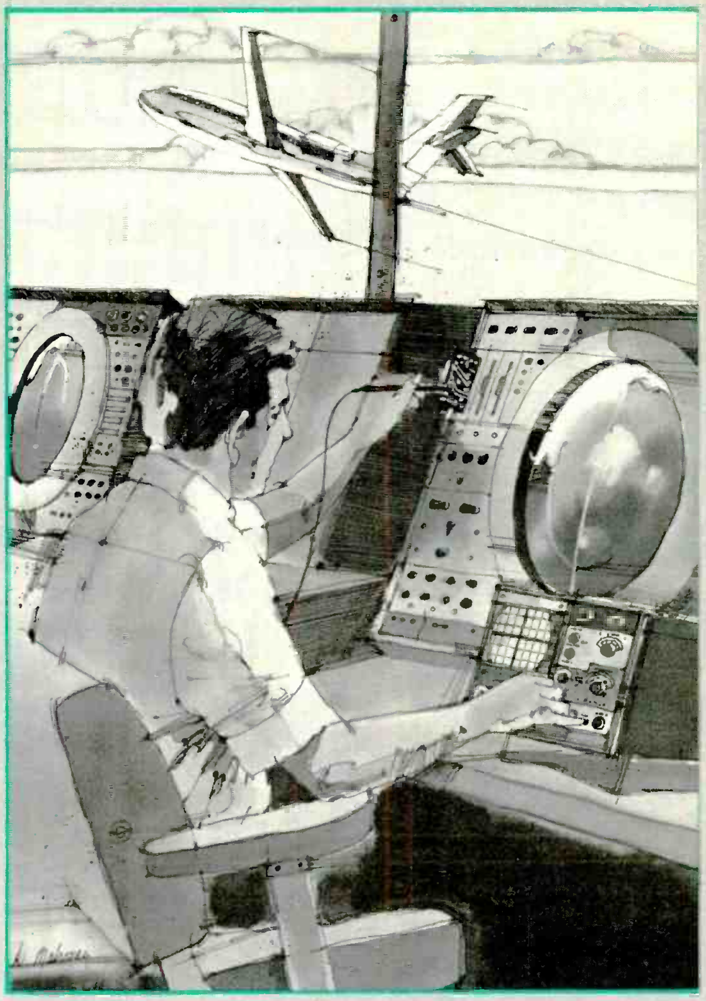

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MO-30

The Booming World Of Consumer Electronics

A special report on the latest, tempting consumer electronic products that manufacturers recently unveiled to retailers

Modern Electronics **Editoral Staff**

Electronic products for the masses are largely introduced to dealers twice a year at massive trade shows produced by the Electronic Industries Association/Consumer Electronics Group. The latest one, the 1985 International Winter Consumer Electronics Show, held in Las Vegas this past January, is the smaller of the two. But smaller is still plenty big, since more than 1,400 exhibitors sprawled way past the giant Convention Center with nearly 75,000 sq. ft. more of display space than last year's winter show.

Manufacturers' wares in every consumer electronics category you can name were displayed, as usual, competing for the attention of more than 100,000 attendees. Here are highlights of what was shown; you'll see some in the flesh by now at many local dealers.

Video

Video today means a lot more than TV receivers. It encompasses videocassette recorders, satellite TV receive-only earth stations, and computer monitors, as well.

From our view, the video hit of the show was Mitsubishi's giant 35"-diagonal color TV set, the largest home CRT ever offered. Its screen dwarfs the 25" CRTs with 80% more viewing area. Yet its 22" depth, aided by 110-degree deflection, compares favorably with a 25" counterpart's 24" depth. The big tube weighs 110 lbs., twice that of a 25" one, and requires a husky 30 kV of high voltage.

The picture it produces is stunningly good, even though a brightness

"There were TV sets for every taste"

level of 170 ft. lamberts is below a 25-incher's 210 fl. A laminated faceplate for better implosion-proofing is responsible for this. You'll not notice the difference, really, since contrast and color-levels are so much better than that of projection TV sets, and the impact of such a big screen that can be seen well from any angle in any lighting environment is so great.

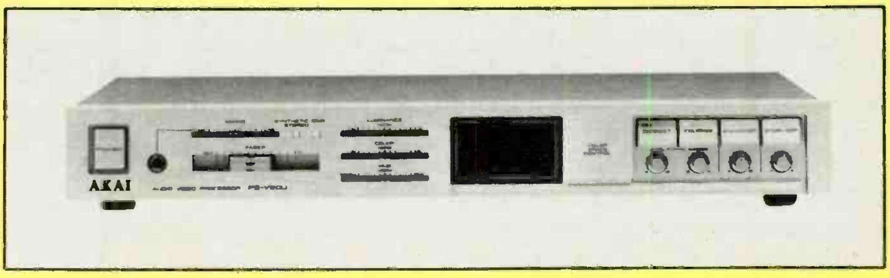
The model is deluxe all the way, with built-in stereo TV broadcast reception, a four-speaker sealed-enclosure system, RGB input, video and stereo inputs and outputs, and other goodies. Expected retail price is around $3,500.

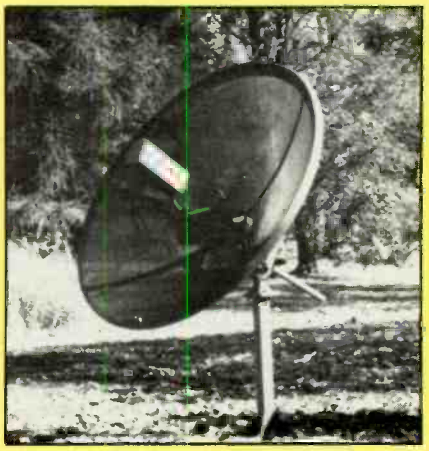
The great variety of video products unveiled underscored the power of visual electronics entertainment. There were TV sets for every taste. Tiny ones with 2″-diagonal CRTs were in evidence, for example, with Sony leading the way with its black-and-white Walkman portable. Magnavox expanded its line with a 1 lb., 2 oz. Escort model with a suggested retail price of $160. Sinclair countered with a flat-screen pocket TV that weighs only 9½ oz. Its 5½″ × 3½″ × 1¼″ dimensions are aided by the use of a Lithium Power Card instead of conventional batteries. Epson and Casio had on display 2″ color TV portable receivers.

Many companies added TV models with 26″ "full square" CRTs, as well as incorporating stereo TV sound into new models. Second-language programming capability is another feature included with some new TV receivers. Zenith introduced the first video receiver to incorporate a built-in teletext decoder, its Omni Series Component Receiver, Model CTG-2083R. It's ready for the text and graphics of North American Broadcast Teletext Standard transmissions on its 20″ screen . . . when it'll happen, though, is anyone's guess. Combination video/audio systems, sometimes called "component TV" and sometimes not, were spotted among all the products displayed, too.

VIDEO GLIMPSES

Some newly introduced video products are highlighted in these photos. Clockwise, Magnavox's "Escort" super-portable TV receiver leads off. Weighing only 1 lb. 2 oz., it has a 2″-diagonal viewing screen. Next is Akai's new PS-V20U Audio/Video Processor, that has everything you want to enhance your video recordings, from colorizing to A/V fading. Following is Polaroid's new 8-mm camcorder, docked in its playback deck, ready to roll on a TV set. Finally, there's Winegard's satellite TV dish, weighing only 47 lbs., that's designed for quick set-up.





"Super video is coming up with 20% better resolution"

Videocassette recorders were at the Show in force, of course. Here, too, the choices were mind boggling. Two-head to six-head machines; top-load and front-load machines; VHS, Beta, and 8 mm; portable types galore, with VHS 20-min. cassette and newly introduced full-size-cassette camcorder units for all-in-one one-the-run video taping. Then there are hi-fi sound types in VHS and Beta format, and stereo machines. Do you want noise-reduction functions or, maybe, a character generator with a video camera? There is seemingly no end to extra features that are available in the world of video—if you're willing to pay for them.

Hi-fi stereo sound with video started with Beta, with VHS machines just now catching up in technology with actual product. Now Beta format has dropped another gauntlet with the introduction of "hi-fi video" that reportedly will be available in winter '85. The Super Beta system is said to produce 300-line horizontal resolution, which is a 20% improvement.

Not to be upstaged for too long by Kodak, Polaroid entered the 8-mm home video system arena with an under-4½-lb. lightweight that uses a solid-state charge-coupled device (CCD) for image sensing. In combination with its playback deck system, a mere $1,650 takes it all. The company also announced a line of videocassette tapes.

And, of course, there were video accessories wherever one turned. These included some video signal transmitters that can transmit a VCR signal to other TV receivers in the area without running any cables around the house. One such system was aptly named, Rabbit. Consisting of two compact modules (for $100), one for transmit and one for receive, the company uses the theme, "The VCR Multiplying System," in its promotional brochure.

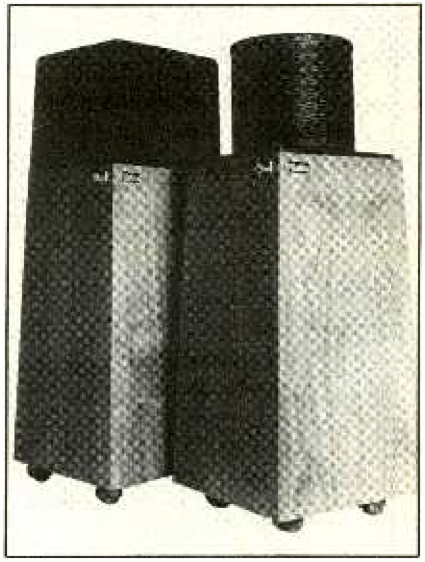
TV satellite earth stations came into their own at this event, with more than a score of exhibitors showing off their products in and outside the convention's buildings. Remote control features were big, as were smaller antenna dishes that went down to six feet; still plenty big. Perforated antennas were offered, too, which would make it easier for self-installation work. There was even a product to enable people to transmit video, a 100-mW vhf to 2.3 GHz microwave up-converter from Galaxy Electronics. The $495 product is said to have a range of up to one mile.

Taken as a whole, the video product lineup should make it very difficult for dealers to pick and choose which ones to carry in their store, as well as challenging consumers trying to make a buying decision. Too much isn't always a good thing.

Audio

Audio products, like video products, have a breadth and depth that can be equally confusing to a prospective buyer. The leading light among audio products was clearly the CD player, whose 4.7"-diameter disc is read by a laser-beam. Digital audio compact disc titles have grown to the point where one now has a wide choice of albums. (For a list of all Compact Disc recordings available in the U.S. through 1984, send a 71¢-self-addressed envelope to The Compact Disc Group, c/o Expose, 30 E. 23rd St., New York, NY 10010.) A smattering of conventional tonearm/platter and linear-tracking players were displayed, too.

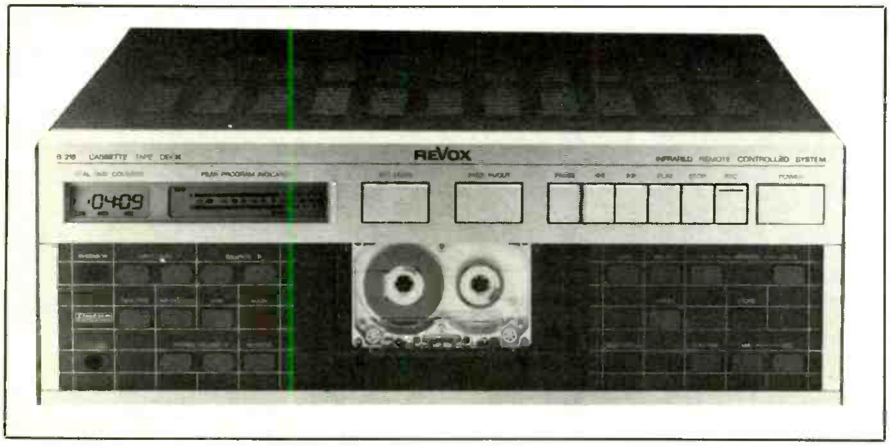
The CD players were touted as "Third Generation" or "New Generation"; some claimed that oversampling at 88.2 kHz reduced phase distortion, while others issued claims for special error-detection circuits. Then there were extra features, such as: wireless remote control, visible disc loading through a prism mirror, fluorescent graphic display . . . and price. The latter is lower, some of them being in the range of top-quality conventional record players.

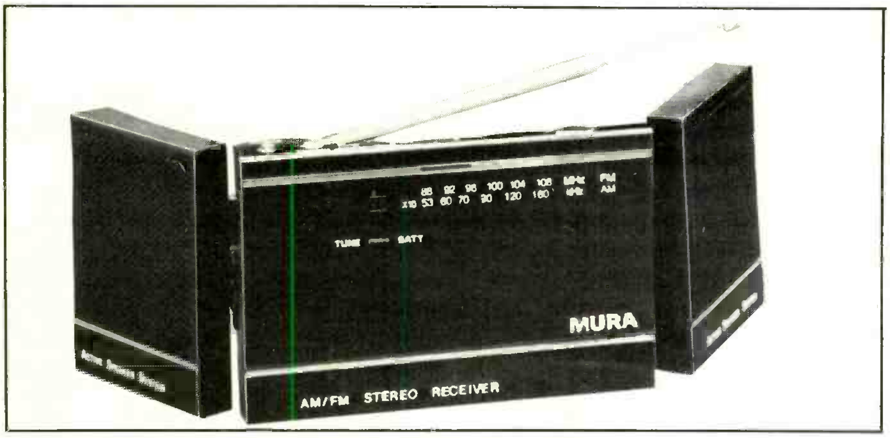


As usual, audio products were well represented at the Show. CD players had more convenience features than ever, such as Technics' multi-function remote controller for its New SL-P3 player. Below it are Ohm Acoustics' distinctive Walsh-3 speakers, a lower-cost version of the company's award-winning Walsh-4s.

" 'Digital Ready' was an omnipresent audio theme"

AUDIO GLIMPSES





From the top, you see Acoustic Researchs' updated version of the venerable AR turntable. Under this is Revox's B215 cassette deck, with control functions galore, including automatic level set and fade in/out. Lastly is Mura's miniature portable, smaller than a pencil in length, featuring swing-out speakers for home stereo use.

There was even a multi-play CD machine from Technics, which loaded 51 CDs at a time, with an option that permits programming for up to 251 discs. Great for anyone wishing more than 7½ days of continuous music! But the traffic-stopper was Sony's portable CD player, hardly bigger than the Compact Disc itself. A pitchman demonstrated it, while models were set up with headphones for show-goers to try the machine out for themselves. One attendee lifted up the player while wearing headphones and shook the diminutive machine violently. "It skipped!" he exclaimed derisively.

An enormous assortment of audio components was at hand, among them, high-power amplifiers, integrated amps, FM tuners, receivers, and one-brand rack systems.

Alpine introduced "holophonically recorded" tape, which has a suggested selling price of $9.95. It's being touted as the most accurate reproduction of the human listening experience. Recordings encoded with Holophonics are decoded with something everyone has, says the company's executive VP, Reese Haggott —the brain! Carver Corp. exhibited its hologram audio electronic components, too as well as its innovative Carver receiver that boasts an FM noise-reduction system.

A noticeable theme carried by some audio equipment makers was, "Digital Ready!" or words to that effect, in an apparent effort to trade on the Compact Disc's improved performance as compared to analog record-playing equipment. NAD's new Model 7130 receiver, for example, carries an "overload-proof" Compact Disc input that supplements a separate AUX input. Revox, in turn, introduced its $1,600 B285 receiver, which is cited as having the power and headroom needed for optimum performance of Compact Discs. Kenwood's 150-watt/channel KA-1100SD, too, has a separate AUX input for CD players that's front-panel switchable so that the CD signal bypasses a subsonic filter.

Technics displayed three new receivers that can accept an optional stereo television adapter, as well as featuring simulated stereo sound capability to enhance mono TV sound signals without the decoder. Pioneer, too, introduced receivers that offered features beyond audio, emphasizing their "video readiness." Its new SX-V300 and SX-V200 receivers, 45 watts/channel and 30 watts/channel, respectively, provide simulated stereo output from a VCR's mono input signal, control facilities for two video units, and on the SX-V300, automatic reduction of tape his from video sources.

For creative audio enthusiasts, Technics showed its 8-lb. SV-100 portable audio processor that enables the user to make digital recordings that are played on a VHS video recorder. It's priced at $900. Pioneer featured a "sound creating system," Model SC-55, for $1,600. It contains a 70-watt/channel amplifier with a host of inputs from phono to Mic/Guitar; separate mixing faders; echo; rhythm; Mic Input equalizer, simulated stereo, and other facilities. Additionally, it has an AM/Stereo FM tuner; belt-driven turntable with a high-output moving-coil cartridge; a double cassette deck that has sound-on-sound recording, synchro start, pitch control, random auto edit, and music search, among other features; a 7-band equalizer; three-way bass-reflex speaker systems; and a rack with two drawers to hold up to 60 cassette tapes, a mic holder, and roll-about casters.

Personal stereos—those tiny, lightweight, go-anywhere receivers commonly used with headphones while walking or jogging along—abounded. A new twist among this popular breed of entertainment electronics was Mura's Model S-1. The $39.95 miniature receiver features two fold-out speakers, converting it into a "home" stereo entertainment center that can also accommodate a cassette player.

New cassette decks were in full bloom at the Winter CES, as well. They ranged from modestly priced ones, such a four new decks introduced by Sherwood Electronics that ranged in price from $159.95 to $249.95, with the top one featuring synchronized dubbing start, front-panel mic mixing, auto reverse, bi-directional cue and review, to ultra-sophisticated ones such as Revox's $1,400 B215. The Swiss-made machine incorporated every feature imaginable, and then some. For example, recording levels are set by the touch of a button (source-signal peaks are sampled); optimum recording biases for six different tape formulations are set automatically; a wireless remote device controls functions; elapsed time is accurately calculated and displayed with accuracy to four seconds; in addition to Dolby B and C noise-reduction circuits, the B215 incorporates the Dolby HX Professional systems; four dc motors are used; and fading in and out to a preset level.

Technic's new $480 Model RS-B85 also features three noise-reduction systems: Dolby B and C and dbx. Among its other features the deck includes three tape heads.

In the speaker arena, Acoustic Research introduced its new Connoisseur Series, three speaker system models ranging in price from the floor-standing Model 30s at $230 each to $160 and $125 each for smaller models. All feature a new 1"-dome driver. A $50 pedestal was introduced for use with Models 19 and 20 speaker systems. Ohm Acoustics debuted its Walsh 3 speaker system, a lower-priced version of its top-of-line Walsh 4 model. It's rated at 200 watts rms on music, and measures 36½"H × 13½" × 13½" at its base, tapering to 10½" × 10½" at top.

For real audio buffs, Nikko introduced its new Labo Crossover Network D-403. The channel dividing network has a 22-point crossover, double midranges, four variable level controls, and 2-point variable gain at 12 dB and 18 dB for stereo or three-way mono versatility.

Autosound

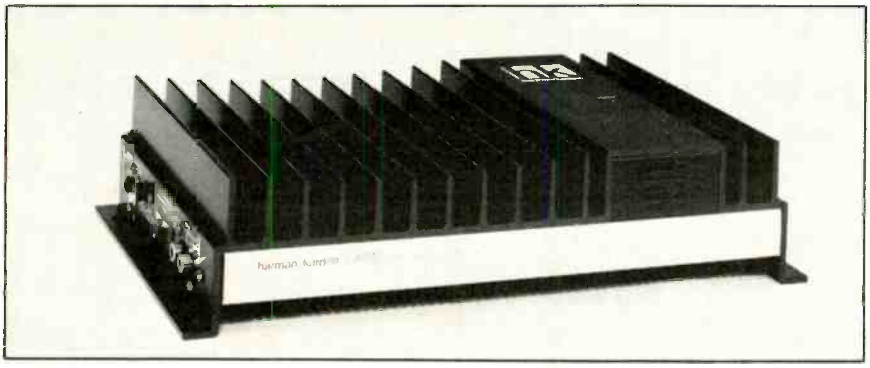
Autosound has been a hot product area for some time. It's sizzling more than ever now. There's still plenty of product jockeying on this track, though. For example, DAT (digital automobile tape) is on the horizon, while competing super-sound Compact Disc auto players are already entering the marketplace.

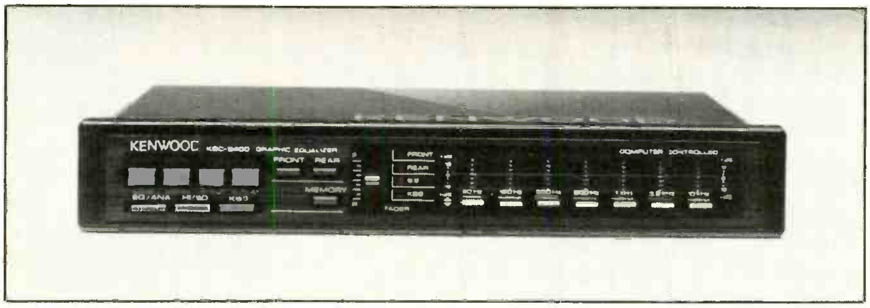
Then there is stereo AM! The perception around town is that Motorola's C-Quam stereo system is winning hands down, with another entry in the market free-for-all, the Kahn system (licensed to Hazeltine) running a poor second.

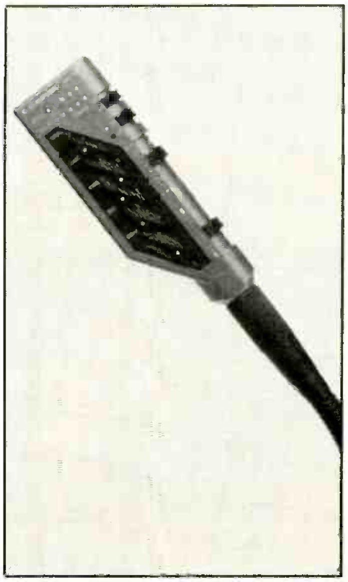
True, there are probably some 185 AM broadcast stations around the country transmitting C-Quam AM Stereo, while Kahn-system users seem to be edging up toward 100. Furthermore, major automobile manufacturers, including GM, are marketing AM stereo radios that incorporate C-Quam for their '85 models. With some investigation, however, *Modern Electronics* learned that the AM-stereo picture is quite different than it appears. Motorola's fine press efforts notwithstanding. For instance, stations employing the Kahn system have a greater listening audience than Motorola-equipped stations do. In Metropolitan New York, for example, the Kahn AM stereo system is used by key stations WQXR, WNBC, WABC, and WHLI. In contrast, the C-Quam AM Stereo system is transmitted by WPAT. Similarly, Kahn has captured the major AM radio stations in Los Angeles, San Francisco, and Chicago, to name just a few big-population areas.

At the Show, some car-radio makers announced new models that in-

AUTOSOUND GLIMPSES







Car stereo listeners get another boost with the following new equipment: Harman/Kardon's $295 CA240 40-watt/channel (into 4 ohms) audio power amplifier. Pictured under it is Kenwood's unusual 7-band graphic equalizer, KGC9400, which features a memory function to recall desirable equalization for particular music recordings. Pioneer brings CD playing to automobiles, while Blaupunkt introduces a shift-stick-like 5-band equalizer/speaker controller, the Model BEQ65.

corporated the C-Quam AM stereo system. But other companies, such as Sony and Sansui, use a system that automatically decodes *any* of the incoming AM stereo transmissions. A wiser approach, it would seem. This gives the end user more stereo bang for the buck.

Interestingly, Kahn is now mail-ordering a product called "The Secret," which automatically switches an AM radio to the appropriate AM stereo decoder mode (Kahn/Hazeltine, Motorola, and Harris systems). Retail price of the add-on, which requires making a few solder connections, is $36.60 plus $1 S&H (Kahn Consumer Products, 425 Merrick Ave., Westbury, NY 11590). So FM watch out, especially since the bandwidth potential of AM is much greater than supposed. Indeed, some car-radio makers with AM stereo provisions have dual-bandwidth switches: 8 to 10 kHz and 4 to 5 kHz. Expect this switching to be done automatically at some future time.

Among the exhibitors featuring Compact Disc players in their line for use in automobiles were Yamaha, Mitsubishi Car Audio, Pioneer Electronics, and Sony, to name a few. Yamaha's model won't be available until the end of '85, though, since the company feels that car CD players are not here yet, but are on the way. Nevertheless, the prototype unit held interest in terms of what's coming up next year. The player used a plastic carrier that holds the Compact Disc for sliding into a loading slot. A shutter built into the cartridge carrier opens up to allow the player's laser beam to track the disc. According to Yamaha, this method protects the disc and the player from "contaminants" and makes it easier for a driver to load a disc. Naturally, it has a floating suspension system to isolate the bumps and vibrations that will occur in a moving car.

(Continued on page 93)

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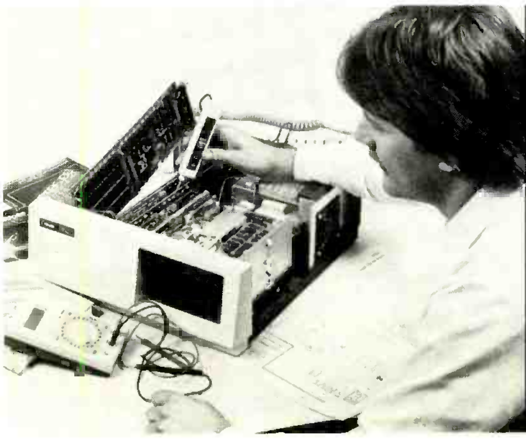

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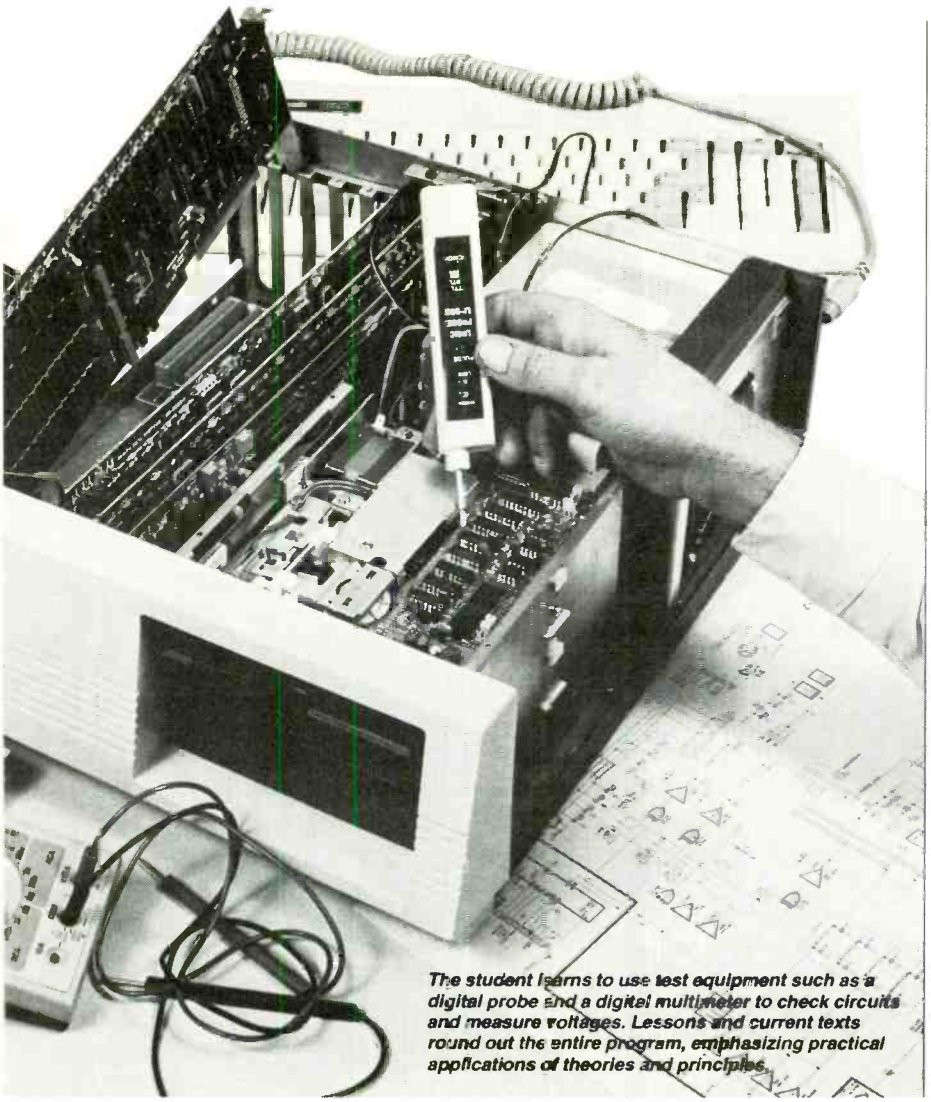

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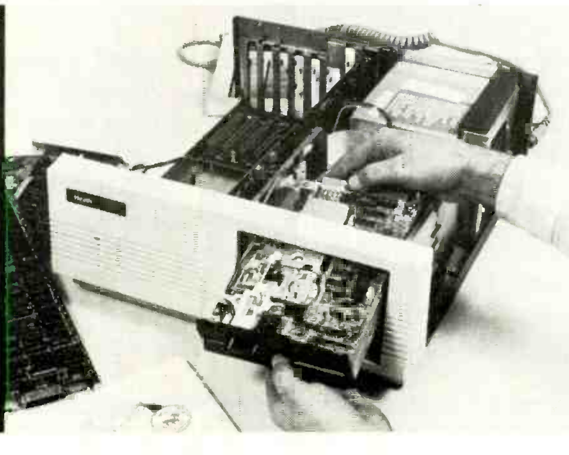

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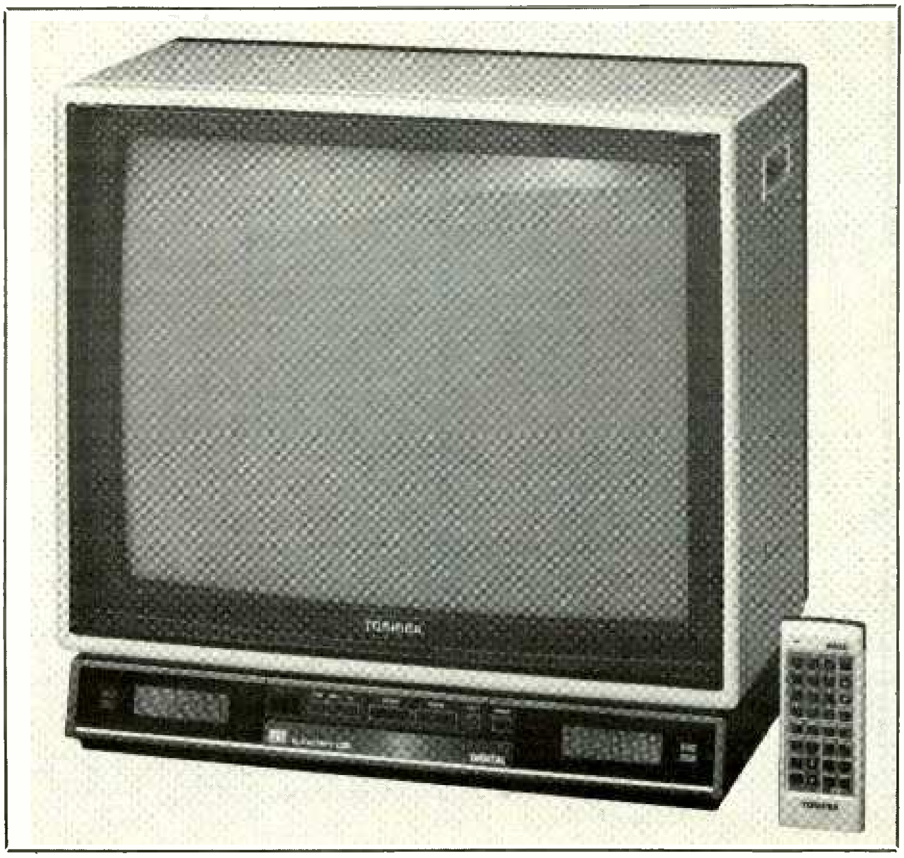
"Digital" Color TV Arrives!

Toshiba's newly introduced digital color TV receiver/monitor spearheads a new video product breed that offers insetting of a second video source on the screen and other special features

By Stan Prentiss



Now that *digital* color TV receiver/monitors are coming into the U.S. consumer marketplace, home video is poised for a whole new concept in video entertainment and information processing. If yours is one of the growing percentage of U.S. households that are supplementing their standard broadcast TV and cable fare with other program sources that demand more performance from your receiver, you're a good candidate for the new digital sets now beginning to appear on dealer shelves. One such receiver/monitor is the Toshiba Model CZ2094 examined here.

The result of a cooperative effort between Toshiba Corp. of Japan and ITT Intermetall GmbH Semiconductor Group of West Germany, the Model CZ2094 has finally broken the 30-year-long monopoly analog receivers have held. Surprisingly, the Model CZ2094 isn't the usual unfinished product rushed to dealer shelves simply to be the first in circulation. It's actually a very complete, finished product and a worthy forerunner of the new generation of sophisticated color TV receiver/monitors. It has practically all of the best digital and analog features currently available, more by far than are obtainable with any analog set currently on the market. Though its price is rather steep at $1199, it's not unreasonable, considering the level of performance and sophistication it offers.

This set's standard features are sure to bring a gleam to the eyes of committed videophiles and monitor users. Topping the list are a Picture In Picture (P.I.P.) feature that places a window in the main picture area in which can be seen a second picture (either in full action or freeze-frame still), located and sized as desired; two different RGB (red/green/blue) inputs for high-resolution text and graphics displays from computers; a BTSC/dbx multichannel sound processor; and a bevy of video and audio inputs and outputs. Its 19" FST (Flattest Squarest Tube) Blackstripe picture tube is designed to provide a wide viewing angle with minimum corner cropping and picture distortion. On-screen alphanumeric and bargraph displays show operating conditions at a glance.

A pair of specially designed rectangular speakers are built in and driven by a resident stereo power amplifier. Terminals and a switch on the rear of the cabinet permit external wider-range speakers to be connected to the receiver/monitor and switched in to provide fuller, richer sound. Finally, supplied with the Model CZ2094 is a very sophisticated 32-key infrared remote control transmitter that gives you full control over the receiver/monitor's functions.

Measuring 19¹¹⁄₁₆"H × 18⅞"W × 18½"D, the Model CZ2094 is promoted as a tabletop/portable receiver/monitor. While its dimensions may qualify it as a portable, its almost 62-pound weight doesn't exactly make it easy to lug from one location to another—no matter how many carrying handholds are molded into its elegant brushed-silver and black plastic enclosure.

Toshiba Model CZ2094 Laboratory Analysis

Ac operating range	90 to 130 V ac
Power drain at 117 V ac (with input signal)	81 to 85 W rms
Voltage regulation (100 to 130 V ac)	
low voltage	134.1 to 134.4 V (99.8%)
	14.7 to 14.8 V (99.3%)
high voltage	28.4 kV (100%)
Tuner/system sensitivity	
vhf channels 4/12	−4/−9 dBmV
uhf channels 15/60	−8/−8 dBmV
Agc swing (before distortion)	59 dB
Dc restoration	90.8%
CRT color temperature	9000°K
Luminance/chroma S/N	43/43 dB
Convergence	99.9%
Barreling/pincushioning/flagwaving	none
Staircase linearity	slight black compression
Horizontal resolution	
through r-f input	4.2 MHz
through baseband video input	5.13 MHz
Vertical resolution (picture center)	450 lines
Stereo separation	>40 dB
Adjacent-channel separation	22 dB
Audio response	
at baseband	>100 kHz
through built-in speakers	variable, −12 dB at 10 kHz

Test Equipment. Tektronix Models 7L5 and 7L12 spectrum analyzers; Hameg Model HM605 oscilloscope; Telequipment Model D66 oscilloscope (modified); Sadelco Model FS-3D VU field-strangth meter; Data Precision Models 245, 945 and 1750 multimeters; B&K-Precision Models 1260 and 1250 NTSC colorbar/multiburst and 3020 sweep function generators; Sencore Model VA 48 video analyst (modified) and PR 57 Powerite; RCA VGM2023S TV receiver/monitor.

General Description

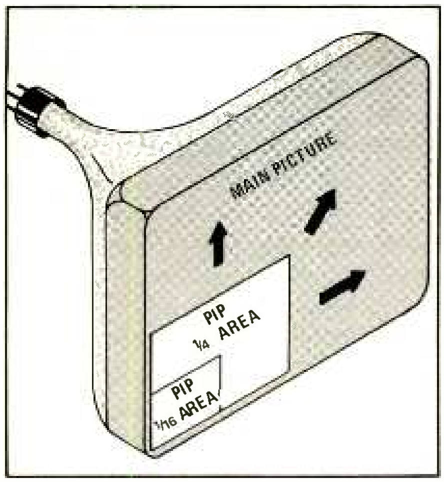
Externally, the Model CZ2094 resembles most of the traditionally analog color TV receiver/monitors introduced into the marketplace during the past few years. Were it not for the DIGITAL legend screened onto the primary control panel, a casual buyer might not even be aware that this set contains the latest in video circuit technology.

Like other receiver/monitors, the front of the Model CZ2094 is dominated by its 20" ultrarectangular bipotential edge-to-edge focusing Blackstripe picture tube. This tube appears to have a 90° deflection angle and a warm 9000° Kelvin color temperature. It also has a much flatter and squarer screen to provide a wider viewing area with less picture distortion and corner cropping. With the receiver using a digital comb filter and the picture tube featuring a finer pitch shadow mask, the screen can display 2000 characters when the monitor function is driven from an RGB input. A smoked tinted glass faceplate, designed to minimize reflections and enhance picture contrast, can be removed is desired.

All local primary controls and the stereo speakers are located in a pedestal-like base upon which the picture-tube assembly sits. The base gives the appearance of being a completely separate unit but is actually an integral part of the set's cabinet.

On the primary control panel are the remote-control receptor and nine light-touch pushbuttons. Three of these, clustered horizontally in a row and labeled RGB, VIDEO and TV, serve as the source selector for the system. Local channel selection and volume level are set by pressing either end of the VOLUME and TUNING bars, which activate up (right) and down (left) scanning. The POWER pushbutton key is set off by itself. Following the trend for most top-of-the-line (and many medium-priced) TV receivers today, the Model CZ2094 has no rotary-type primary controls.

So far, all the primary controls are self-explanatory, but the final button, labeled EJECT, needs some explanation. Pressing the EJECT button causes a door below the primary control panel to pop open and drop down to provide access to the secondary controls located on a panel inside the Inner Control Box. These controls carry such legends as STR/L2, MONO, RGB HORIZONTAL POSITION LEFT and RIGHT, RGB CONTRAST UP and DOWN, CONT 1 and 2 UP and DOWN, RESET, channel programming ADD and ERASE, memory NORMAL/PROGRAMMING, and NORM/CATV



The smaller PIP picture can be sized to be ¼ or 1/16 the size of the main picture and can be positioned in any of the four corners of the screen.

band switching. Enumerating the control complement here isn't meant to give you a blow-by-blow rundown on how the set is used, but to show you the level of sophistication built into the Model CZ2094. The manual that comes with the receiver/monitor gives full details on what these controls are and how to use them. Also on this subpanel are VIDEO/AUDIO INPUT 3 and TV VIDEO/AUDIO OUTPUT jacks.

Local sound is generated by a pair of flat, rectangular two-way speaker drivers located on either side of the control panel. These drivers consist of 2″×4″ woofers with 0.8″-square tweeters mounted on their frames. The arrangement is designed to provide better-than-avrage local stereo sound reproduction. However, for viewers who want fuller, richer sound, external wide-range speaker systems can be switched in and driven by the 5-watt/channel stereo amplifier built into the Model CZ2094.

The control lineup provides plenty of latitude for performing all necessary programming, except for setting a sleep timer and adjusting the PIP feature. However, more controls are located behind another cabinet door. These provide the means for setting PIP contrast, brightness, tint, and color. The sleep timer is set with the remote controller.

The rear subpanel of the Model CZ2094 isn't like anything you might expect for a color TV receiver/monitor. Contained here are the usual 300-ohm UHF and 75-ohm coaxial VHF antenna input connectors. In addition to these, there are push-type speaker-output terminals, each clearly labeled according to phase and with the "hot" (+) terminals colored red, designed to accommodate high-efficiency 8-ohm external speaker systems. Alongside the external speaker terminals is a slide switch that in one position switches in the internal speakers and in the other selects the external speakers.

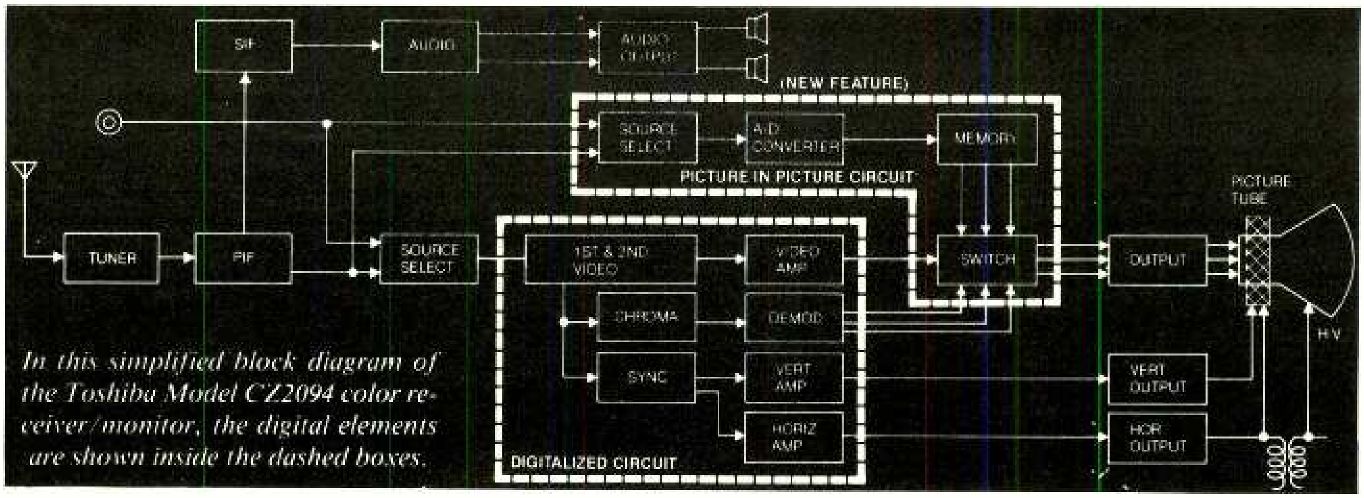
On the rear subpanel you'll also find three sets of audio and video jacks that permit up to three program sources (VCR, video disc and video game console, for example) to be connected to the receiver/monitor. The two sets of video outputs facilitate video/audio tape dubbing. To the right of the jack cluster are the 21-and 8-pin RGB connectors that are used for computer monitor applications, while below there are a pair of push-push button switches labeled VCR. One switches between VCR and TV horizontal afc, the other between VCR and TV chroma.

Tuning in the Model CZ2094 is accomplished all-electronically with an all-channel phase-locked-loop (PLL) controlled frequency-synthesized tuner. This tuner can be set to bring in any of 139 channels in the vhf, uhf and cable midband, superband and hyperband ranges. As each channel is selected, its number appears in a green-bordered, back-background window on the CRT screen. This is followed about two seconds later with an on-screen bargraph-like display of mono or stereo sound level. The same occurs for videos 1, 2 and 3, except that the sound level is not displayed.

Toshiba's P.I.P. (Picture In Picture) feature is unique to digital receiver/monitors. Activating this feature lets you put on the screen a window through which you can view a video source other than the one you're presently watching. This window can be located in any one of the four corners of the screen. Furthermore, you can adjust the size of the window so that it occupies either ¼ or 1/16 of the screen area. On top of all this, you can have the window display full action or a freeze-frame still picture. This last is another feature that can be obtained only with a digital monitor/receiver.

There are 32 calculator-like keys on the digital Comput-R-Tune random-access remote-control transmitter supplied with the receiver/monitor. Anything you want to and can do with this system can be accomplished with a light press on one or more of the controller's keys.

As you use the remote controller's velvety smooth keys, you'll become familiar with such terms as PIP, QUAD, SOURCE, SWAP, STILL, RGB, CONT-1, CONT-2, STR/L2, TIMER, and all the usual video and audio programming controls. You already know what PIP stands for. STR/L2 refers to stereo sound, QUAD stands for quadrant or quadrangle and designates PIP placement on the screen, while SOURCE can be either from a video (baseband) input or from off-the-air programs. SWAP swaps the PIP and main pictures on the screen, STILL displays a freeze-frame picture stored in memory in the stop mode (like with a VCR, only better), and TIMER can automatically turn off (but not on) the receiver after any preprogrammed period of up to 180 minutes. Finally, CONT-1 controls bass, treble and stereo separation and causes a moveable bargraph



In this simplified block diagram of the Toshiba Model CZ2094 color receiver/monitor, the digital elements are shown inside the dashed boxes.

scale to be displayed on-screen as you adjust, while CONT-2 does the same for color, sharpness, brightness, tint and contrast. If all this seems like too much to digest at one sitting, however, you have the option of hitting the RESET key on the controller to call up the factory-preset parameters so you won't have to do without your viewing.

Two series-connected AAA cells® provide the 3-volt dc power required for operating the hand-held remote-control transmitter. The controller measures 5½"L × 2¼"W × ⅝"D and is housed inside a charcoal-and-silver plastic box that matches the coloration of the receiver/monitor.

The green-bordered, black-background window that appears on-screen serves as a status display. It's called up whenever a status function key on the remote controller is activated. These conditions range from channel number to source selected to picture condition to sound level displays in alphanumerics or bargraph format. They remain on-screen for as long as it takes to complete programming and can be recalled at will simply by tapping the appropriate keys on the controller.

Theory Of Operation

There's no way we can include a precise block diagram or schematic of Toshiba's Model CZ2094 color TV receiver/monitor. Even if we had the space for them, they just aren't available at this time. However, we can offer a reasonable working description, using the block diagram of ITT's Digit 2000 system, which is basically similar to the Model CZ2094, though if offers more features to satisfy a wider international market (see large block diagram). Devices not currently in the U.S. digital sets include the SPU2220 SECAM chroma processor; TPU2700 teletext processor; VPU220 video processor; DPU2500 deflection processor; CCU2000/2030 central controls; ADC2300 and APU audio A/D (analog-to-digital) converter and processor; and VCU2100 video codec. Though a CVPU NTSC comb filter isn't included in the diagram, it is most definitely a part of the U.S. version, as is the APC2230 automatic picture (fleshtone) control on certain future models.

Action beings with the infrared pulse-code transmitter sending out 10-bit words that are usually separated into 4 to 6 bits, or 16 addresses and 64 commands. An RC oscillator does the job adequately here, since the remote receiver measures start and data-pulse intervals and stores them for later time-slot comparison and first data pulse recognition to establish time synchronization.

•*Central Control Unit.* The CCU 2000/2030 receives channel-selection, volume, brightness, color, volume, tone, etc., information and develops a frequency-synthesized PLL tuning system that has a 62.5-kHz resolution. The CCU communicates with digital signal processors for video, audio and deflection, via the serial IM bus and the MDA 1024-bit EEPROM. The MDA has sufficient memory to store 30 TV channels, preferred settings for audio and video, and preprogrammed factory alignment information. Both ICs contain an 8-bit 8045-family microprocessor with differing RAM and ROM capacities, the larger being the CCU2030. Crystal-controlled clock frequencies range between 3.5 and 4.6 MHz, depending on the system.

•*Video Codec.* The VCU2100 converts video analog information to digital form and then back into analog form and includes two video amplifiers, a noise inverter, one D/A converter for luminance, two D/A converters for chroma, one RGB matrix, three RGB output amplifiers, and programmable auxiliaries for blanking, brightness adjustment, picture (position) alignment, and beam-current limiting. For U.S.

NTSC receivers, the VCU is replaced by a pin-compatible CVPU2210 comb-filter processor that has better video specifications. There are also brightness adjust and automatic black and white balance controls and beam-current limiting. A 14.3-MHz clock frequency develops from the MCU2600 clock generator for the four 8-bit converters.

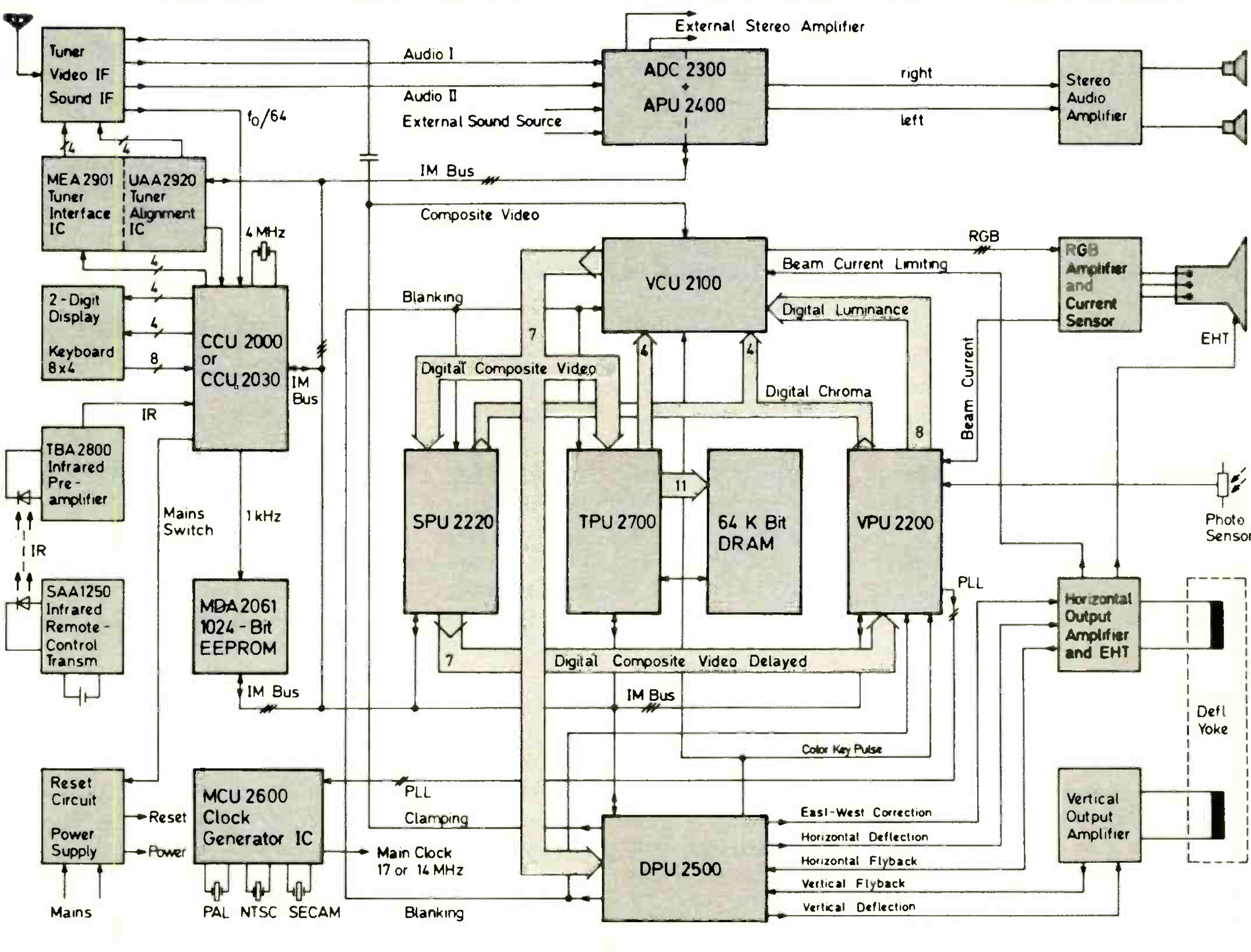
• *Video Processor.* The VPU2200 digitally processes video from the CVPU2210 in a 40-pin NMOS package that contains a code converter, chroma bandpass filter, contrast multiplier and luminance limiter. Additional circuits on this chip include automatic color control (ACC), color killer, NTSC comb filter, hue corrector, color saturation multiplier and multiplexer, dark current, white level, and photo current measuring stages.

•*Deflection Processor.* The DPU 2500 executes analog clamping, horizontal and vertical sync separation, sawtooth generation, and east-west parabolic correction circuits. Programmable are horizontal sync filter time constants, duration and phase of horizontal output, vertical amplitude, position, S-correction, sync swithover, and NTSC, PAL and SECAM selection.

•*Audio A/D Converter.* The ADC 2300 digitizes mono and stereo sound with two pulse-density modulators, five analog switches, and an analog stereo decoder matrix that extracts left and right signals. Then one-bit streams at 4.7 MHz transfer information to the APU2400 audio processor and its digital audio filter contained in another IC. Here, modulated inputs are converted to parallel data; dematrixed; deemphasized; volume, loudness, bass and treble controlled; and stereo bandwidth enlarged. The mono, stereo or bilingual mode is then

(Continued on page 90)

ITT's Digit 2000 block diagram illustrates the new technology being used in digital TV receiver/monitors.



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11205	20	.20	.18	.16
11206	22	.22	.20	.18
11207	24	.24	.22	.20
11208	28	.28	.26	.25
11209	40	.40	.37	.33

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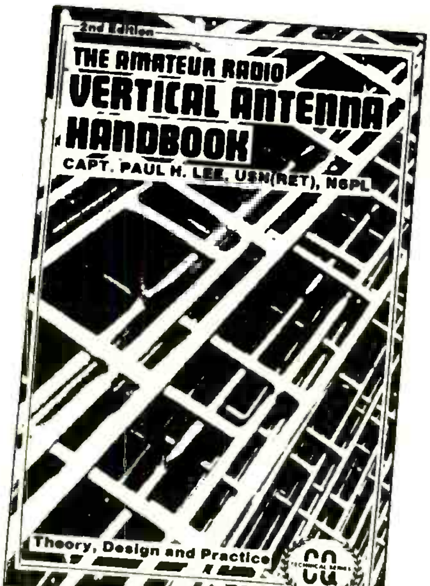

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Transferring BASIC Programs From One Computer to Another

Details on an efficient way to transfer BASIC programs written for other computers to yours, using an Apple IIc as an example

By Fred Blechman, K6UGT

There are literally thousands of programs written in BASIC for microcomputers. Should you wish to run one that's written for another computer than your machine, or vice versa, there are some bumps in the road ahead of you. Assuming the program is written in some dialect of Microsoft BASIC, as most are, you have to make appropriate language changes to meet the target computer's requirements. Some translations are straightforward, while others border on the impossible, especially where graphics are concerned.

Before making translations, though, you must get the original BASIC into the target computer's memory so that you can make any changes in syntax and key words to allow the target computer to run the program. You can enter the program on the target computer's keyboard, of course. But this is a tiresome chore that, additionally, invites typing mistakes that have to be debugged. To avoid the drudgery, BASIC programs are best transferred in or out of a computer in ASCII (American Standard Code for Information Interchange). This converts BASIC "tokens" (key words) to individual characters so that the program is not machine-specific, saving you considerable time and ensuring an accurate transfer.

Most computers provide a simple method for converting a BASIC program from tokenized form to ASCII. Unfortunately, Applesoft BASIC does not. Since Apple computer models are so widespread, I'll use one of them, the Apple IIc, which is among the more popular personal computers sold today, as an example of how to make the program transfer efficient and painless. With this done, you would run the program, trying out equivalent key words whenever a line crashes. A bonus for Apple IIc owners will be some technical information, such as connector pin-outs, that the beautiful IIc manual neglects.

Note: This article is based upon material in the author's book Apple IIc—An Intelligent Guide, *soon to be published by Holt, Rinehart & Winston (CBS Computer Books).*

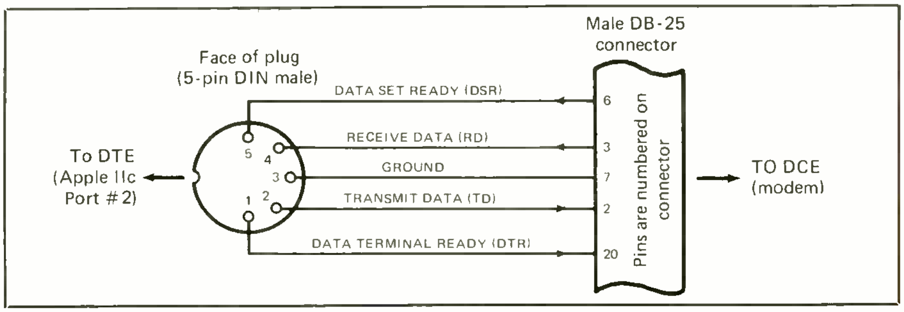

Fig. 1. This drawing shows details of modem interface cable connections between the 5-pin DIN and standard DB-25 connectors.

Computer-To-Computer Transfer

It is relatively simple to transfer programs directly between two computers if you have the proper equipment and the source and target computers sitting physically close to each other. You can use a null cable to directly connect the two together. If the computers are located distantly from each other, however, you will have to add modems and operate through the telephone lines.

For the sake of illustration, let us assume you wish to transfer a BASIC

(Continued on page 42)

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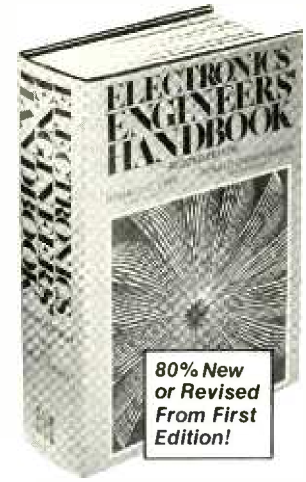

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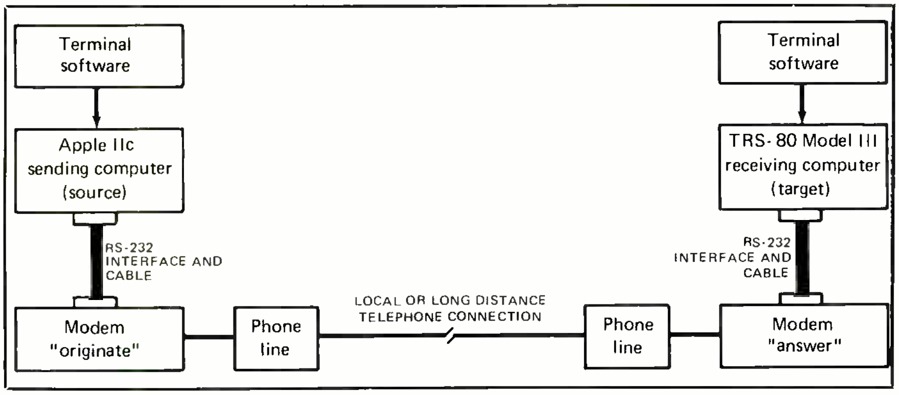


Fig. 2. Diagram illustrates typical telecommunications systems, using RS-232 interface and cable and modem at each end of phone line.

program from a TRS-80 Model III disk system to an Apple IIc. While this example will discuss specifics for transferring data between these two computers, the general approach can be used with just about any other combination of microcomputer.

Terminal Programs. Each computer will require a "smart" terminal program that can upload and download (send and receive) programs either directly from disk or from a memory-storage area called the *buffer*. Many such programs are available for the TRS-80 Model III and for most other micros. This is not true for the Apple IIc, however.

Although there are many terminal programs for earlier Apple II-series computers, most of them will not work in the IIc. Fortunately, by the time you read this, several are expected to be available.

It is best if the terminal programs support the Christensen protocol, also know as the XMODEM, MODEM7, and CP/M protocols. This method of transferring files, using 128-byte verified blocks, assures virtually error-free transfers.

RS-232 Interface. You need an RS-232 (serial) interface installed in each computer. The Apple IIc has this built in and uses Port No. 2 for this purpose. An RS-232 interface is frequently included with the TRS-80 Model III or is available as an option.

Similarly, most common microcomputers have RS-232 interfaces built in or available as options for $75 to $100.

Cables & Time. Getting the equipment you need to transfer programs should not be a problem. However, plan on spending considerable time finding or making the special cables you will probably require for use with the Apple IIc. Also, getting acquainted with the terminal software for each computer can be very time-consuming. Each comes with documentation that describes its particular features and operation, and it seems that no two are the same!

The Computer Connection

Entire books have been written on the subject of telecommunications, so it would be presumptuous to attempt to cover this subject in detail in this article. If you need information on telecommunications, consult any of the books on the market.

Inferfacing an Apple IIc to a modem is simple and straightforward—if you use an Apple modem. Unfortunately, Apple charges a premium price for its equipment. Too, you may already have a modem from a source other than Apple. If you wish to avoid the challenge of interfacing a non-Apple modem to your IIc, with its resultant uncertainties, I suggest that you pay the premium price and get an Apple modem. For those who are more adventurous (or are on a tighter budget) I'll cover some alternatives.

Example Only. For the example of transferring programs from the TRS-80 Model III to the Apple IIc, I will assume you have a modem, an RS-232 interface for the TRS-80, and a terminal program for each computer, and that you know how to operate the modems and use the terminal programs. This being the case, I will simply review the procedures to use.

Modem Connection. Figure 1 illustrates a typical modem interface cable for the IIc, while Fig. 2 shows the two computers connected together via modems and the telephone line. The latter approach requires two different telephone numbers, a necessity if the two computers are not near each other.

Hard-Wire Connection. Since my TRS-80 and IIc were just a few feet apart and not wanting to tie up my phone for hours as I tested the programs and procedures, I eliminated the phone lines and both modems by making a direct RS-232-to-RS-232 connection (Fig. 3). I did this by using the Port No. 2 cable shown in Fig. 1 and a standard RS-232 cable. In most cases, this works better than using modems and somewhat simplifies the procedure, since the phones and modems are bypassed. Also transfers at higher rates—9600 baud, for example—are practical with direct wiring, if the terminal programs can handle the higher transfer rate.

You may be puzzled by the "null modem adapter" shown in Fig. 3. The RS-232 interface wires 2 (transmitted data) and 3 (received data), normally connected straight-through to a modem, must be interchanged if you directly wire two computers together. Otherwise, you will get no response.

The foregoing is done because both computers are acting like terminals (DTE, or data terminal equipment). The RS-232 standard expects a DTE to be connected to a modem (DCE, or data communication equipment), with wires 2 and 3 connected straight-through.

Signals are transmitted from the DTE to the modem on pin 2 and are received on pin 3 of the DTE. However, if two DTEs are connected in this manner, they will both be attempting to send on pin 2 and receive on pin 3. This problem is solved simply by swapping the wires on pins 2 and 3 of the conventional DB-25 RS-232 interface connector. You can buy a commercial unit, called a *null modem adapter* for $10 to $20, or make your own from male and female DB-25 connectors.

Incidentally, this same wire interchange is necessary when using a printer. So a serial printer cable made for use with the Apple IIc can be used for direct wiring between two computers, eliminating the need for a null modem adapter.

Preparation. Connect the hardware together as described. However, before you actually start transferring data or programs between computers, determine what data or program you want to transfer and establish the target computer. The most important thing to realize is that the transmitted file, whether a BASIC program or a data file, should be in ASCII format when transmitted. Since most text and data files are in ASCII, they are normally not a problem. BASIC programs, however, do pose a problem.

Note: Strictly speaking, some terminal programs allow direct transmission of BASIC programs between like computers, using the Christensen protocol. However, this can lead to immense confusion and problems between different computers. So plan on direct transmission of BASIC programs only if you really know what you are doing. ASCII files are much more compatible.

Since BASIC programs are normally saved in binary (also called *tokenized* or *compressed*) format, you must first change any BASIC file to the ASCII format. You do this by loading the program into your BASIC memory and then saving it on disk with the filename followed by a comma and an A, for most computers. Unfortunately, you cannot do this in Applesoft BASIC, but we will get to this later.

For example, ORDER/BAS on a TRS-80 would be loaded with the LOAD"ORDER/BAS" command and then saved with the SAVE"ORDER/ASC",A command. The extension /ASC could actually be any three-letter code, but this is the most commonly used to designate that the file is in ASCII format, to distinguish it from the /BAS binary file. The ,A after the filename tells the computer to save this program in ASCII format. *This is very important!*

Matching Baud Rates. It is extremely important that the baud rate and word format (signal rate and sequence) be the same at both the transmitting and the receiving ends of the telecommunications link. Accomplishing this is a matter of using merely whatever commands are required in the terminal program to set baud rate (usually 300 or 1200 when using modems) and word format (usually eight data bits, one stop bit and one parity bit).

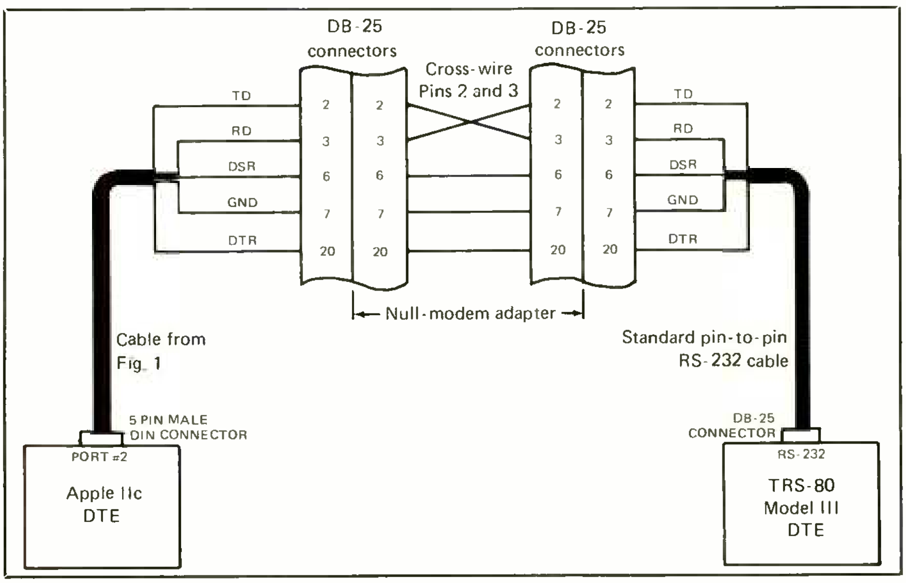
Unfortunately, as is so common with Apple equipment, the IIc departs from the norm, with a default serial port setting of two stop bits. My advice is to leave the IIc settings alone, since they are inconvenient to change with some IIc terminal programs. Change the other computer, if necessary—and it might not be, since many computers ignore the difference between one and two stop bits.

Baud rate must be matched. There should be no problem communicating at 1200 baud over the phone lines, but use 300 baud if a lot of errors interrupt program transfer. Furthermore, some early Apple IIcs have a problem with 1200-baud transmission, due to a design oversight. To communicate at 1200 baud, the modems at both ends must be designed for that protocol, or 300 baud must be used. Fortunately, the default for IIc's Port No. 2 is 300 baud.

Step-By-Step

Perhaps the best way to describe the procedure for transferring a BASIC

Fig. 3. Details for directly connecting two computers, both acting as DTEs.



program is to "walk" you through an actual example, using the TRS-80 Model III as the source computer. Remember that you would use a similar procedure with another computer. While the following describes data transfer using direct wiring, transfer using modems is essentially the same.

(1) ASCII. If you are planning to transfer just text or data (not programs), this step is not necessary. However, if you are going to send a BASIC program, you can eliminate a lot of problems by first converting it to ASCII format.

This is easy to do on most microcomputers, since a program can be saved in either tokenized form or in ASCII. Unfortunately, the Apple does not provide this convenience. (A method to do this will be covered later in this article).

I loaded into the TRS-80 Model III's memory the BASIC program I wanted to transfer to my Apple IIc and then saved it in ASCII with the SAVE"PROGRAM/ASC",A command.

(2). Terminal Programs. With the program to be transferred in ASCII format, I got the terminal programs up and running in both computers. I used OMNITERM in the Model III and EasyCom/EasyGo in the IIc. (OMNITERM sells for $95 from Lindberg Systems, 41 Fairhill Rd., Holden, MA 01520. EasyCom/EasyGo sells for $129 from Transend Corp., 2190 Paragon Dr., San Jose, CA 95131.)

I used a direct cable connection between the two computers. The procedure to make the transfer would be the same with modems, except for the additional task of setting one modem to "originate" and the other to "answer," and making the call from one to the other to establish the link.

(3) Setting Parameters. With OMNITERM running in the Model III, I used the various menus (on-screen choices) to set the computer's transfer rate at 300 baud, since that is the default setting for the IIc's terminal program. You can get fancy after you have learned to do transfers, but I suggest that you leave everything "plain vanilla" at the start.

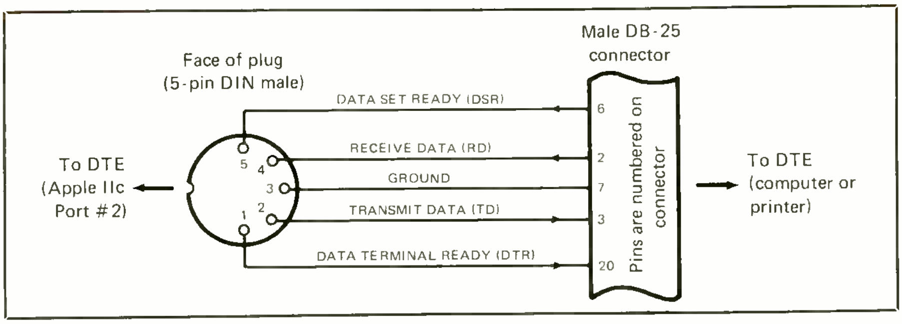


Fig. 4. This drawing shows how a printer cable can be used to eliminate the need for a null modem adapter.

(4) File Transfer. Next, I used the appropriate commands in OMNITERM to load PROGRAM/ASC into the Model III's buffer, where is resided waiting to be transferred.

I then put the Apple IIc into the terminal mode so that it could receive and display incoming text. Returning to the Model III, I selected the OUTPUT FROM BUFFER function. It was a pleasure to watch the IIc screen as the program zipped over to it through the cable coming from the Model III. In a short time, each screen indicated that program transfer had been completed successfully.

Some terminal programs will automatically save this incoming program as a TXT (text) file. Others will save it in a buffer for you to modify and then save to disk—still as a TXT file. In any case, you cannot use this file as a program until it is converted to a BASIC program file; otherwise, it will not load into BASIC.

(5) File Conversion. Some terminal progams for the IIc have provision for converting an ASCII text file to a BASIC file. If you have such a conversion program, and learn how to use it, fine. However, there is a very simple and effective alternate way to do this:

(A) Save the incoming program on a IIc disk, using whatever means your terminal program provides.

(B) Get out of the terminal program and into Applesoft BASIC.

(C) Type "EXEC filename" (without the quotes), using the disk filename you assigned the incoming program when you capture it from the source computer.

(D) The disk drive will load (but not run) the text file into memory just as if you had typed it in from the keyboard. You will see only right-bracketed symbols (carriage returns) on the screen at this point, ending with a blinking cursor.

(E) Do not attempt to run the program yet. Simply save it on disk with another filename, and it will be saved as a BASIC program.

(F) Now you can attempt to run it and modify it any way you please, since it is in its "virgin" form on-disk under a new filename, in case it crashes during translation. If it was originally an Applesoft program, it might run as-is. If not, you might have to make extensive revisions to make it run.

Transferring Apple IIc BASIC

You may have occasion to transfer an Apple IIc's Applesoft BASIC program to another computer. Here, again, plan on using ASCII for the transfer. Although many terminal programs support the Christensen protocol, a remarkably effective "error-free" transmission method, ASCII transfers are more universally utilized.

To convert an Applesoft BASIC program into ASCII text format, follow these steps, suggested by Harold H. Stuart of Sun Data Software:

(A) In Applesoft BASIC, load the target program into memory. Then list it and note the lowest program number. If this number is less than or greater than 10, retype and/or renumber the lines so that the program starts with line number 10.

(B) Using the keyboard, type in the listing:

```
1 D$ = CHR$ (4)
2 HOME : POKE 33,33
3 PRINT "CONVERT BASIC FILE TO
    TEXT FILE."
4 PRINT : INPUT "NEW FILE
    NAME? ";F$
5 PRINT D$;"OPEN";F$
6 PRINT D$;"WRITE";F$
7 LIST 10 -
8 PRINT D$;"CLOSE"
9 POKE 33,30: END
```

This short program is designed to create a text file of your BASIC program, starting with program line 10.

(C) Run the new integrated program. The screen will clear, announce its purpose, and prompt with "NEW FILENAME?" Type in a different filename from the original program name so the new ASCII file to be created will not destroy the original BASIC file.

(D) After entering the new filename, press RETURN to write a new file to the disk in ASCII text format.

(E) This new file can then be transmitted with your terminal program and be converted back to BASIC by the target computer. For an Apple, the EXEC command described above does the job. With other companies, this conversion is frequently done with a word processor.

EXEC ASCII File

If you plan to do a lot of the foregoing work, you will not want to type in the above listing for every conversion. Here is a neat way to create an ASCII version of the listing, suggested by Jeffrey Mazur:

(A) While in BASIC, type NEW and hit RETURN. Then type in lines 1 through 9 from above.

(B) Add the following:

```
10 D$=CHR$(4)
20 PRINT D$;"OPEN ASCII"
30 PRINT D$;"WRITE ASCII"
40 LIST 1-9
50 PRINT D$;"CLOSE"
```

(C) Check the above carefully. Then type RUN 10 and hit RETURN. Lines 10 through 50 will create a text file of lines 1 through 9, with a filename of ASCII.

(D) To use this file, first load in the BASIC file you want converted to ASCII. Make sure the starting line number of the program is 10. If it is not, change it so that it is. Then type EXEC ASCII and hit RETURN to add lines 1 through 9 to the beginning of your BASIC program. This puts you right where you want to be, in the position to run the new integrated program.

A Lot Of Work?

This may seem like a lot of work just to transfer a BASIC program, and it is. It is also a lot *more* work to hand key in a long program, not to mention the extra time you will have to spend finding all your typing errors!

Though the transfer of programs to or from an Apple computer is inherently more complicated than it is with most other computers (since there are no direct ASCII conversions), once you learn the procedure you can save a lot of time, energy and frustration. Of course, you will still face the challenge of translation if the program is not Apple IIc-compatible. But that is another story. ME

Experimenter's Interface Device

Simple add-on device lets you explore electronic control with your home computer

By Kendra R. Bonnett & Dovell M. Bonnett

Fighting off alien invaders, running household budgets, and playing music on your home computer certainly has appeal—at least initially. But once this attraction has worn off, some people may come to regard their home computer as little more than an expensive doorstop. If so, you may be ready for another dimension in home computing—electronic control. If you're imaginative, you'll soon find that the applications to which you can put your computer are far-ranging. For example, you can use your computer as a digital multimeter, an electronic thermometer, a home security system, or even a computerized weather station, to mention just a few applications.

Applications to which you can put your computer are limited only by your imagination and technical expertise. All you need, aside from knowing what to do and how to go about doing it, is the data on your computer's input/output (I/O) port and an interface, such as the Experimenter's Interface Device that will be described here. This EID offers fully buffered I/O lines between the interface and your computer, its own 5-volt dc power supply, a breadboarding area for building your own hardware projects, and an interface cable.

The Experimenter's Interface Device is designed to connect to the 24-pin user port of the Commodore 64 computer. However, it can easily be adapted to use with other home computers.

(1) Identifying User Port Pins

Before you can design an interface, you must determine the function of each pin on the input/output (I/O) port, direction of signal travel through each pin, and whether or not

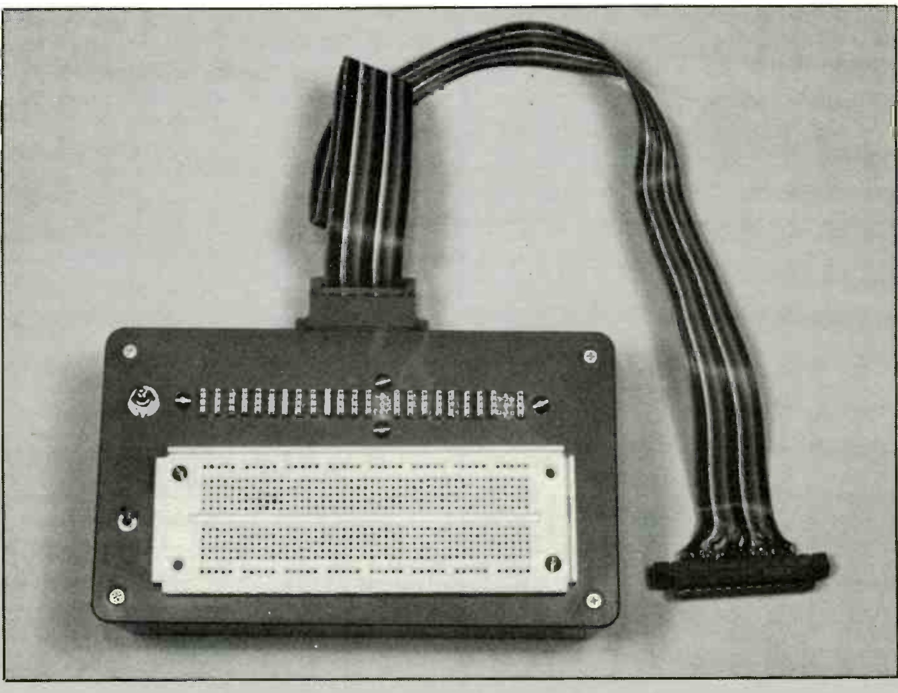


Photo shows completed project, with interface cable attached. The large white area on top of box is a solderless breadboarding block on which experimental circuits are assembled. Smaller white blocks in cutout area are for distributing power and input/output lines per circuit requirements.

buffering is needed. It helps to keep a journal or notebook when starting a project like this.

Most of the information you need concerning the user port can be found on pages 360 and 421 of the *Commodore 64 Programmer's Reference Guide* (available from Commodore Business Machines, Inc. and Howard W. Sams). This information is summarized in Table I. Note in the table the shorthand notations "bi" and "uni" in the column headed "direction." Here, "bi" means bidirectional, indicating that data can travel from the computer to an external device and from the external device to the computer (but not both ways simultaneously). Similarly, "uni" means unidirectional, indicating that data can flow in only one direction, either into or out of the computer. Using conventional current-flow theory, the "in" will receive (sink) current into the computer, while "out" will transmit (source) current from the computer.

(2) Selecting The Buffer ICs

Because the four ground (GND), +9V, −9V, +5, and RESET pins are used to power other devices, and not as control or data lines, they do not require buffering. All remaining pins, however, do require buffering —14 bidirectional and two undirectional buffers in all. Two 74LS245 bidirectional and one 74LS367 unidirectional buffer ICs are almost ideal for this application.

One pin on the 74LS245 provides control over the direction in which data travels through the buffers. Both ICs have a pin that allows the chips to be enabled and disabled. By wiring these control pins to switches and powering the chips with a 5-volt power supply independent of the computer's 5-volt dc output (see Fig. 1), you can change the direction of signal flow and enable and disable the buffers with two switches.

Buffers serve two important purposes in the Experimenter's Interface Device. First, they protect the computer from any outside voltage that may occur as you're experimenting with external circuits on the project's breadboard. By isolating these voltages, you prevent your computer from damage simply by turning off (disabling) the buffers so that no voltage can enter the system. Second, long wires have resistances, which create voltage drops between the computer and external device. Buf-

PARTS LIST

Semiconductors
IC1—LM 340 5-volt regulator
IC2—74LS367 hex bus driver
IC3,IC4—74LS245 octal bus transceiver
Capacitors
C1—0.22-µF epoxy
C2—0.1-µF tantalum
Resistors
R1—1000-ohm, ¼-watt, 10% resistor
Miscellaneous
S1—Dpst toggle switch
S2—Spst toggle switch
Wire Wrap sockets (two 20-pin, one 16-pin); 9-volt dc, 500-mA ac adapter (RadioShack No. 273-1651); subminiature jack (Radio Shack No. 274-297); experimenter's IC perfboard (Radio Shack No. 276-150); TO-220 heat sink (for IC1); solderless female DB-25 connector; chassis-mount male DB-25 connector; 24-contact pc-board edge connector; 36" or so 24-conductor ribbon cable; blank (no copper cladding) perforated board with 0.1" hole centers (one each 6"×4½"×2¾"); large solderless breadboarding socket; 2 pkgs. 4-contact Klip-Strip solderless terminal blocks (Vector Electronic No. T45-4DP); 7½"×4½"×2½" plastic utility box; self-stick rubber feet; yellow, red and blue 30-gauge Kynar-insulated wire; red and black 22-gauge stranded hookup wire; Wire Wrap socket ID tags (optional); 6-32 machine hardware; plastic board separators (8); solder; etc.

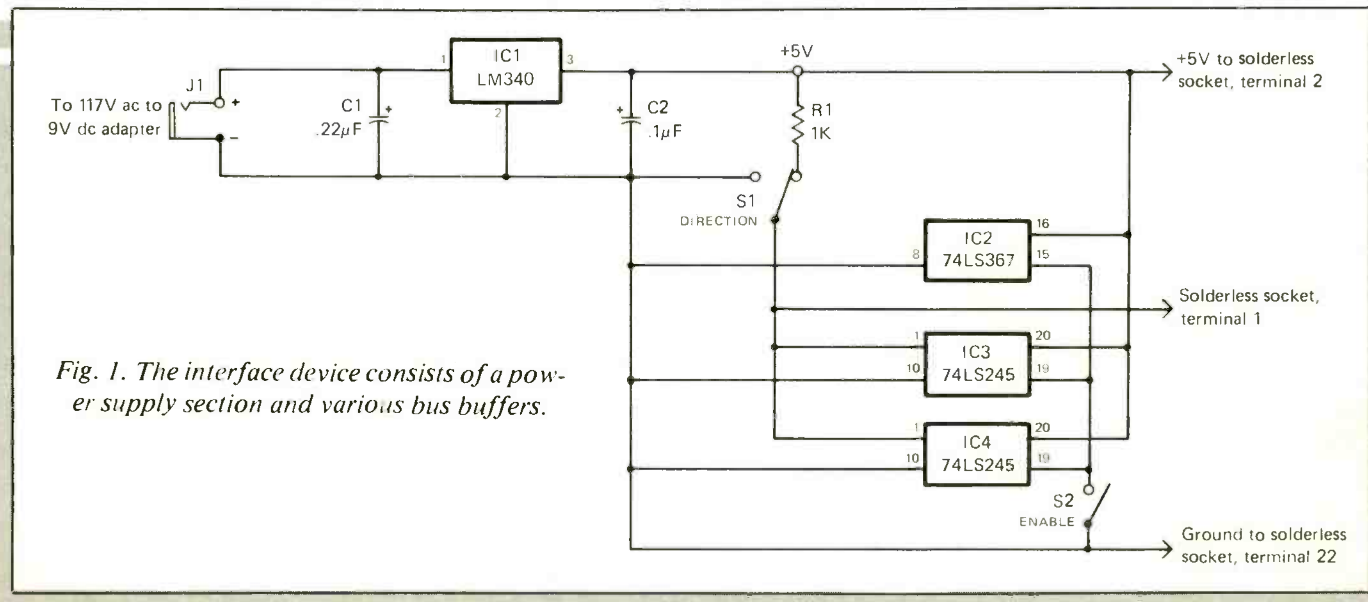


Fig. 1. The interface device consists of a power supply section and various bus buffers.

fers help keep signals true and actually amplify the signal if necessary.

Tri-state noninverting buffers, such as those specified in the Parts List, are a good choice because they can be enabled and disabled by a separate pin on the buffer ICs without having to physically disconnect the interface device from your computer.

(3) The 5-Volt Power Supply

According to the data sheets, the V_{CC} supply voltage required by the buffer ICs is 5 volts dc. For the 74LS245s, maximum current drain (I_{CC} is specified at 105 mA, while that for the 74LS367 is 24 mA. The maximum total current demand of the three ICs, then, is 234 mA (105 + 105 + 24 = 234 mA), which is more than twice the 100-mA current available from the C-64 computer at its +5-volt user-port pin. It should be obvious, then, that a 5-volt dc power supply, independent of the C-64's +5-volt line, is needed for the Experimenter's Interface Device.

You can make an independent +5-volt dc power supply with a commonly available dc adapter (see Parts List) that converts 117 volts ac to 9 volts dc and a garden-variety 5-volt IC voltage regulator. This arrangement gives you 5 volts dc at 500 mA, which is more than enough for powering the buffer ICs.

Begin building the power supply by drilling the four 3/16" holes in the corners of the experimenter's IC perfboard, as shown in Fig. 2. If your perfboard already has small holes in the corners, do *not* try to enlarge them with a drill. Instead, move in about ¼" and start fresh. This done, lightly rub the copper traces with fine steel wool until they are shiny bright, to remove oxides.

Bend the leads of voltage regulator *IC1* back toward the rear, about ⅛" from where they exit the body of the IC, forming a 90° angle with each. Then mount the heat sink to the back of the IC with its fins pointing up. Use a 6-32 × ¼" machine screw and nut to secure it in place.

Insert the three regulator leads into three adjacent three-hole pads on the perfboard and solder them to the holes in the pads closest to the edge of the board. (This and all subsequent steps are illustrated in Fig. 2.)

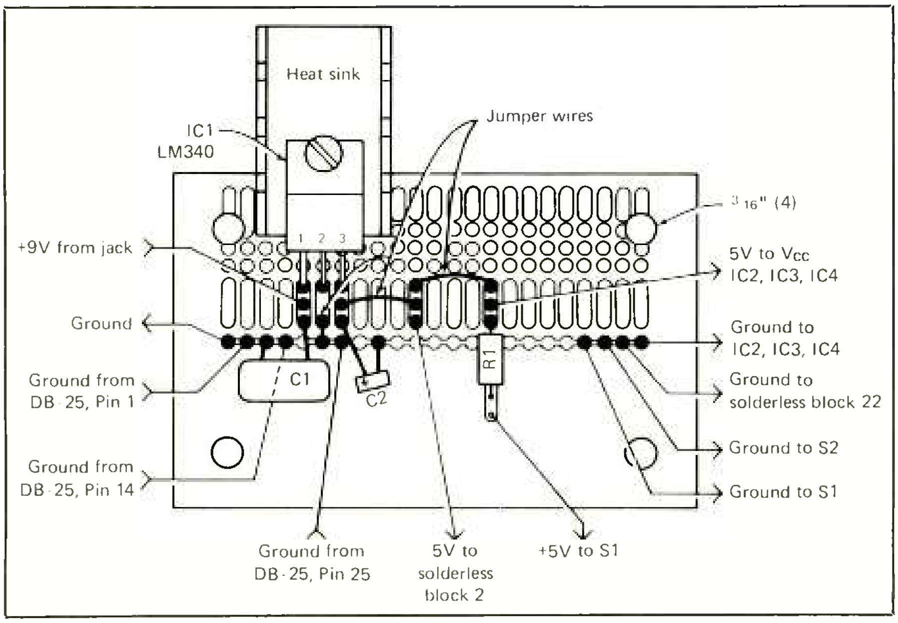
With *IC2* in place on the board, the long multiple-hole bus nearest the pads to which it is soldered serves as the system ground bus. Connect and

Table I. C-64 User Port Pin Identifications

PIN	FUNCTION	DIRECTION	BUFFER	REMARKS
1	GND	uni (in)	none	connect all grounds
2	+5 V dc	uni (out)	none	100 mA maximum
3	RESET	uni (out)	none	
4	CNT1	bi	74LS245	control line
5	SP	bi	74LS245	control line
6	CNT2	bi	74LS245	control line
7	SP2	bi	74LS245	control line
8	PC2	uni (out)	74LS367	control line
9	SERIAL ATN	bi	74LS245	control line
10	+9 V	uni (out)	none	
11	−9 V	uni (in)	none	
12	GND	uni (in)	none	connect all grounds
A	GND	bi	none	connect all grounds
B	FLAG2	bi	74LS367	control line
C	PB0	bi	74LS245	data line
D	PB1	bi	74LS245	data line
E	PB2	bi	74LS245	data line
F	PB3	bi	74LS245	data line
H	PB4	bi	74LS245	data line
J	PB5	bi	74LS245	data line
K	PB6	bi	74LS245	data line
L	PB7	bi	74LS245	data line
M	PA2	bi	74LS245	data line
N	GND	uni (in)	none	connect all grounds

bi = bidirectional; uni = unidirectional

Fig. 2. Drawing illustrates details for assembling power supply module.



solder a short wire jumper from the *IC2* pin 2 pad to the ground bus. Similarly, connect and solder *C2* from the *IC1* pin 1 pad to the ground bus and the long positive lead of *C2* (the capacitor's case is also usually marked with a plus sign to identify the positive lead) to the *IC1* pin 3 pad and the negative lead to the long multiple-hole ground bus.

Solder a short wire jumper from the *IC1* pin 3 pad to another three-hole pad and a second wire jumper from the latter pad to yet another three-hole pad. Then install *R1* from the bottom hole in this last pad to another three-hole pad *below* the ground bus. (This is a current-limiting resistor, used to protect the ICs by limiting the current coming through direction control switch *S1*.)

Strip ¼" of insulation from two red and two black wires, each 7" long. Tightly twist together the fine wires at each end and tin with solder. Insert one end of the two black wires into one of the free holes at the left and right of the ground bus and solder. Solder one end of a red wire to the *IC1* pin 1 pad and one end of the other red wire to the free hole in the pad to which *R1* and the wire jumper are connected. (The red wire connected to the *IC1* pin 1 pad and black wire at the left end of the ground bus are the positive and negative leads, respectively, for the 9-volt adapter jack. The other red and black wires connected to the *R1* pad and right side of the ground bus are the +5-volt and ground outputs from the power supply to the buffers.)

The 9-volt dc adapter comes with two different types of plug sockets. Connect the ⅛" solid shaft one to the end of the adapter. Insert the shaft into the jack and plug the adapter into an ac outlet. (Don't worry, you won't get a shock.)

Set a dc voltmeter for a full-scale deflection of slightly greater than 9 volts. Connect the meter's common lead to one post on the jack and briefly touch the positive lead to the other

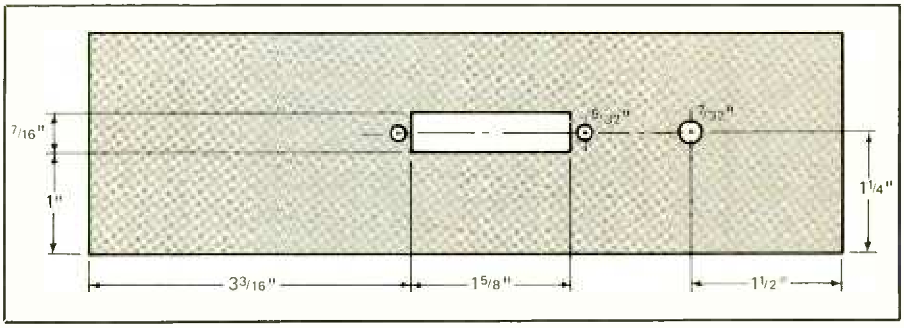


Fig. 3. One long wall of the box in which the interface device is housed must be machined to accommodate the D connector and ac adapter jack.

jack post. If you get a negative reading, reverse the leads. The indication you're looking for is +9 volts. When you get this, the common lead is connected to the negative jack post. Make a note of this. Then unplug the adpater from the ac outlet.

Solder the red wire coming from *IC1* pin 1 to the positive jack post. Then solder the black wire from the left end of the ground bus to the other jack post.

Once again plug the adapter into an ac outlet and the adapter into the jack. Connect the voltmeter to the free ends of the other red and black wires (positive to red and common to black) and observe the meter reading. The reading should be close to 5 volts. (Warning: If you remove the small plug socket from the shaft of the ac adapter, be sure you replace it exactly as it was. Otherwise, you risk reversing the negative and positive leads and damaging your 5-volt dc power supply.)

Insert the short ends of the plastic separators into the four holes you drilled in the power supply board. Temporarily set aside the power supply module.

(4) Preparing The Box

The plastic box specified in the Parts List will readily accommodate all the parts that make up the Experimenter's Interface Device proper. A plastic box is recommended for two reasons. First, it is much easier to machine than metal. Second, it will not short any circuitry or wiring that might come in contact with it.

Preparation of the box is detailed in Fig. 3. It consists of cutting a slot for a DB-25 connector and drilling its mounting holes and drilling the mounting hole for the adapter jack. After removing the top of the box, draw the outline of the connector slot and indicate where to drill the hole for the adapter jack. The slot cuts easily with a coping saw. To get started, drill a ¼" hole in the center of the slot area. Then use the saw to trim away all unwanted plastic. Finish the job with a file. (You want the connector to fit snugly in the slot. So don't overdo the sawing and filing.)

Set the chassis-mount male DB-25 connector into the slot and trace its mounting-hole outlines onto the box. Remove the connector and drill the two 5/32" holes. Change to a 7/32" bit and drill the hole for the adapter jack. Test fit the jack. If the fit is too light, use a reamer or small round file to slightly enlarge it. Don't mount the jack yet.

(5) The Buffer Section

Using Fig. 4 as a guide, drill the four 3/16" holes for the plastic separators and the two 9/64" board-mounting holes in the 6" × 4½" perforated board. Cut the *long* pins off the remaining four plastic separators and set aside the separators.

Set the power supply module on the perforated board, positioned so that the edges of the module line up

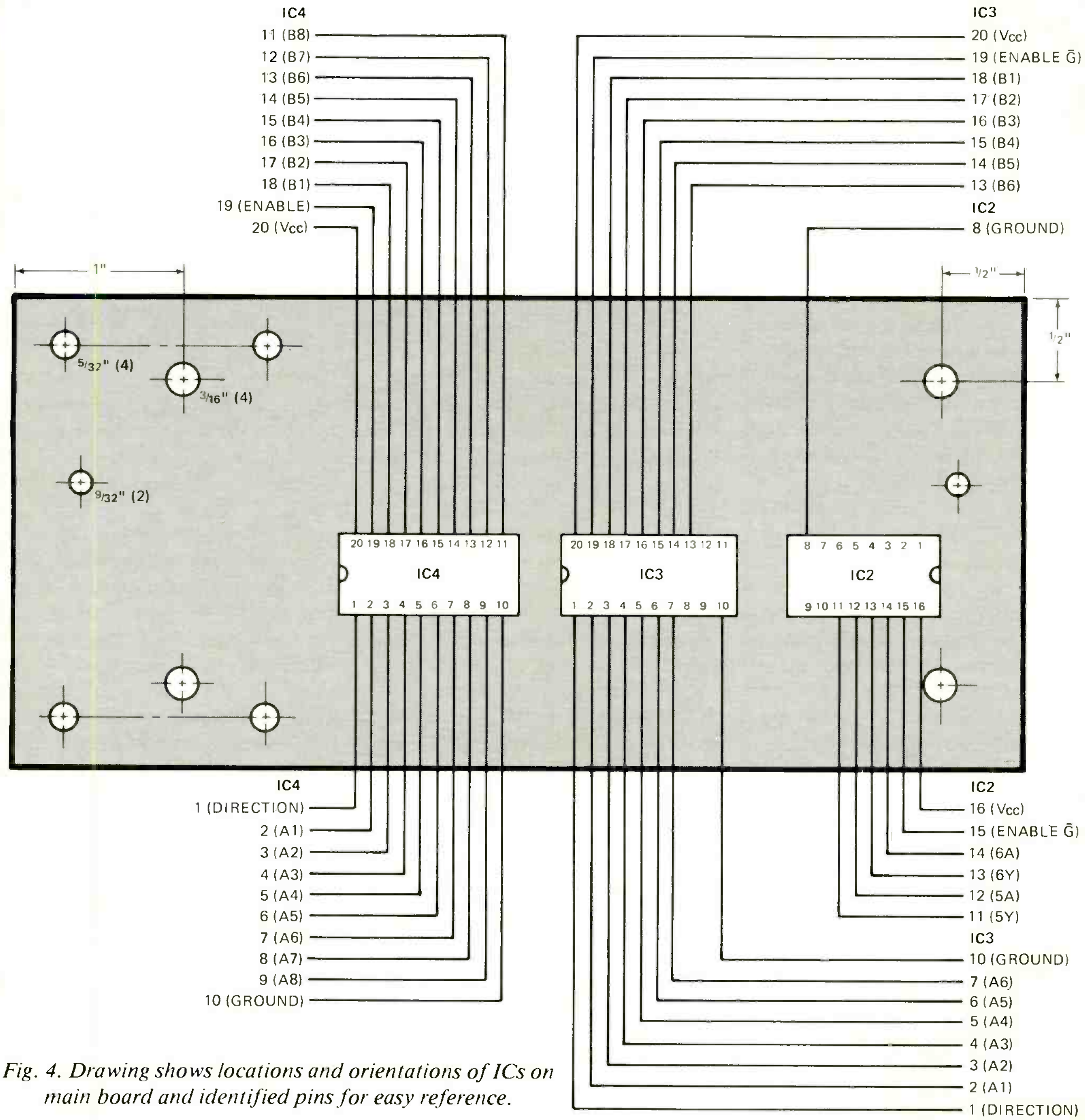


Fig. 4. Drawing shows locations and orientations of ICs on main board and identified pins for easy reference.

with the edges of the board. Each of the long pins of the module will sit in a hole on the board. Therefore, mark the locations of the separators on the board, remove and set aside the power supply module, and drill the four 5/32" holes at the marked locations on the perforated board.

Locate and drill the 9/64" holes at the ends of the perforated board. The locations of these holes aren't critical. Just make sure the hardware used for the hole at the right end of the board will not touch the *IC2* socket that will be mounted nearby.

Set the power supply module on the perforated board but don't push the pins of the plastic spacers home yet. Orient the plastic box with the connector slot facing away from you. Place the perforated board and power supply inside the box, with the latter to your right. Make sure nothing touches the sides of the box. Holding the perforated board in place, remove and set aside the power supply module and trace the locations of the ⁹⁄₆₄″ holes onto the floor of the box. Remove the board and drill these holes.

(6) Wiring The Buffers

Wiring of the buffers is done in three stages, working first on the input, next on the output, and finally on the power supply and switch connections. In input and output wiring, keep the wires 7″ long to provide enough slack for maneuvering parts when the circuit is disassembled.

Install a 20-pin Wire Wrap socket on the perforated board in the *IC4* location (see Fig. 4). Orient the socket so that pin 1 is in the bottom-left corner with the layout shown. Insert the other 20-pin socket in the *IC3* location and the 16-pin socket in the *IC2* location. Note that pin 1 for *IC3* is in the lower-left corner, while pin 1 for *IC2* is in the upper-right corner. Leave enough space between the *IC2* socket and the screw hole at the end of the board to prevent a washer and screw used here from touching the socket. You may want to slip Wire Wrap ID tags over the socket pins for easy identification during wiring.

Use yellow 30-gauge Kynar wire to interconnect the pins of the male DB-25 connector and the pins of the Wire Wrap sockets. (Refer to Figs. 4 and 5 and the Master Wiring Chart in Table II.) Strip ⅛″ of insulation from one end of each wire that is to be connected to the DB-25 connector but leave the other ends as they are.

Keep in mind that bare wire exposed beyond the solder terminals on the connector could cause short circuits. So try to have the insulation come right up to the solder, and use only enough solder and heat to assure electrically and mechanically secure connections.

Feed the wires through the slot in the box to the connector and down through the holes from the top of the board in line with the pins on the IC sockets to which they are to connect. Use the holes located two spaces away from the pins.

Table II. Master Wiring Chart

Input	Output	Connect To	Function
IC4: pin 1		S1 toggle	direction control
pin 2		DB-25 pin: 23	PB0
pin 3		22	PB1
pin 4		21	PB2
pin 5		20	PB3
pin 6		19	PB4
pin 7		18	PB5
pin 8		17	PB6
pin 9		16	PB7
pin 10		power supply GND	IC ground
	pin 11	SB14	PB7
	pin 12	SB15	PB6
	pin 13	SB16	PB5
	pin 14	SB17	PB4
	pin 15	SB18	PB3
	pin 16	SB19	PB2
	pin 17	SB20	PB1
	pin 18	SB21	PB0
pin 19		S2 toggle	enable to ground
pin 20		power supply +5V	IC V_{cc}
IC3: pin 1		IC4 pin 1	Direction control
pin 2		DB-25 pin: 24	PA2
pin 3		9	serial ant
pin 4		7	SP2
pin 5		6	CNT2
pin 6		5	SP1
pin 7		4	CNT1
pin 10		IC4 pin 10	IC ground
	pin 13	SB4	CNT1
	pin 14	SB5	SP1
	pin 15	SB6	CNT2
	pin 16	SB7	SP2
	pin 17	SB11	serial ant
	pin 18	SB10	PA2
pin 19		IC4 pin 19	enable to ground
pin 20		IC4 pin 20	IC V_{cc}
IC2: pin 8		IC3 pin 10	IC ground
	pin 11	SB8	PC2
pin 12		DB-25 pin 8	PC2
	pin 13	DB-25 pin 15	FLAG2
pin 14		SB8	FLAG2
pin 15		IC3 pin 19	enable to ground
pin 16		IC3 pin 20	IC V_{cc}

From	To	
DB-25 pin 3	SB3	RESET
DB-25 pin 10	SB12	+9V
DB-25 pins 1, 14, 25	power supply GND	computer ground pins
power supply GND	S2	enable
power supply GND	S1	direction control
power supply GND	SB22	ground
+5V from R1	S2	direction control
power supply +5V	SB2	interface +5-volt power
S1 toggle	SB!	direction control

Note: SBn = solderless terminal block; *n* = the assigned number of the block.

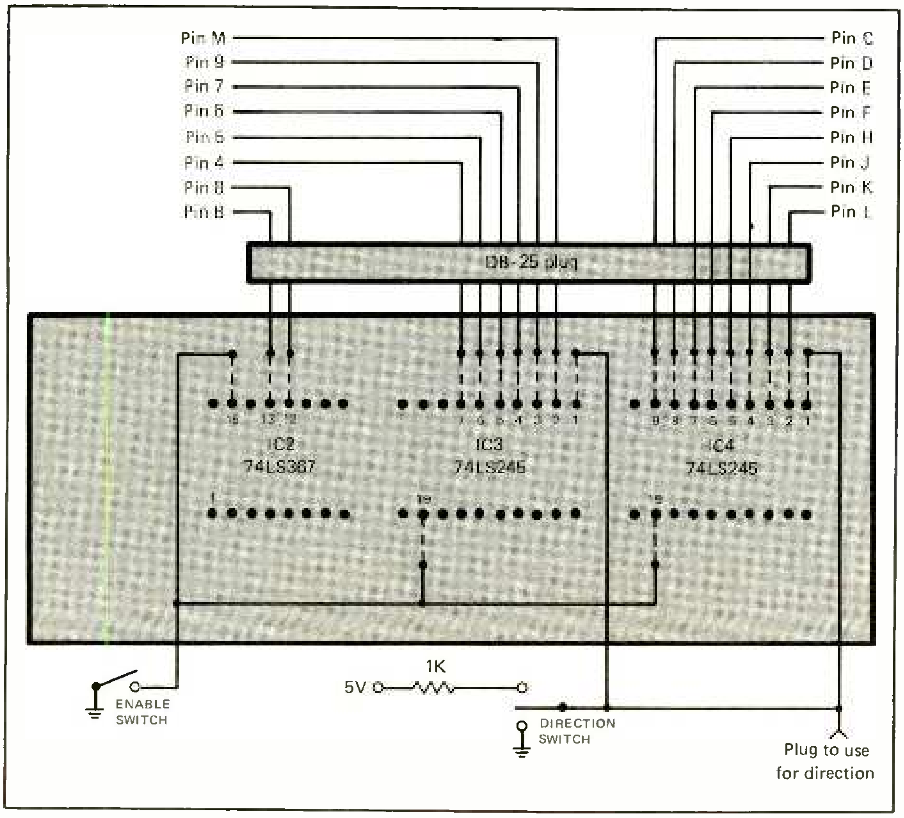


Fig. 5. Illustrated are details for wiring switches into circuit and interconnections between main board and DB-25 connector to edge connector.

Wrap the wires around the socket pins with a Wire Wrap tool. It's a good idea to wrap all wires to the input pins of the IC sockets and then tackle the soldering at the DB-25 connector end.

Use red Kynar wire to connect between the output pins of the IC sockets and the solderless terminal blocks on the top of the box. Strip ¼″ of insulation from one end of each of these wires but leave the other ends as they are. Wire Wrap the unprepared ends of these wires to the appropriate pins on the IC sockets (see Table II).

Feed the free ends of the wires up through the second row of holes in the perforated board, in line with the pins to which they're connected, just as you did for the input lines. The free ends of these wires will be connected to the lugs on the solderless terminal blocks later.

Wrap the red stranded wire coming from the pad on the power supply module to which the top end of *R1* is connected around pin 20 of the *IC4* socket. Jumper a 3″ red stranded wire from pin 20 of the *IC4* socket to pin 20 of the *IC3* socket and a second 3″ red wire from pin 20 of the *IC3* socket to pin 16 of the *IC2* socket.

Wrap the free end of the black stranded wire coming from the right side of the ground bus in the power supply module to pin 10 of the *IC4* socket. Jumper a 3″ black stranded wire from pin 10 of the *IC4* socket to pin 10 of the *IC3* socket and a second 3″ black wire from pin 10 of the *IC3* socket to pin 8 of the *IC2* socket.

Carefully inspect all stranded-wire wrapped connections to make certain that they're connected to the appropriate pins on the sockets and that no wires are touching pins to which they shouldn't be connected. Then solder all wrapped connections. (See Figs. 2, 4 and 5 and Table II for all connection details.)

Strip ¼″ of insulation from one end of each of two 7″ lengths of blue Kynar wire. Wrap the unprepared end of one of these wires around pin 1 of the *IC4* socket and connect and solder the other end to the center lug on *S1* (Fig. 5). Jumper a short blue Kynar wire from pin 1 of the *IC4* socket to pin 1 of the *IC3* socket. Wrap the unprepared end of the other 7″ Kynar wire around pin 19 of the *IC4* socket and connect and solder the other end to either lug of *S2*. Jumper a short length of blue Kynar wire from pin 19 of the *IC4* socket to pin 19 of the *IC3* socket to pin 15 of the *IC2* socket.

Solder a 7″ red stranded wire to one of the holes in the lower pad to which *R1* is connected in the power supply. Solder the end to one of the outer lugs on *S1*. Solder another 7″ red stranded wire to the pad to which the jumpers from pin 2 of *IC1* and the top of *R1* connect. The other end of this wire will be connected later.

Trim away ¼″ of insulation from both ends of each of six 7″ black stranded wires. Twist together the fine wires at each end and tin with solder. Insert one end of each of these wires into a free hole in the ground bus in the power supply module and solder. This done, solder the free ends of three of these wires to pins 1, 14 and 25 of the DB-25 connector. (Don't forget to route these wires through the slot.) Solder another of these wires to the other outer lug of *S1* and yet another to the lug of *S2* to which nothing is connected. The remaining wire will be connected later.

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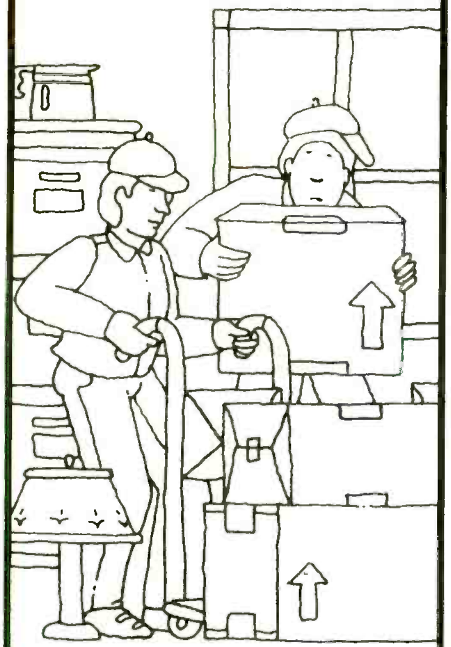

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Precision Voltage Sources You Can Build

How to design and build simple, stable precision reference supplies

By Joseph J. Carr

A source of accurate voltages can open up new circuit-measuring vistas for you. With it you can check out the accuracy of that nifty new digital multimeter you just bought or see if your old meter has maintained its calibration over the years. The same can be applied to oscilloscopes, power supplies, and other equipment. You might even wish to improve the voltage reference source of an A/D or D/A converter in the event that a shabby reference supply is giving you 4-bit performance out of an 8-bit data converter.

This article discusses how to design and build simple, but effective, reference supplies that can be used for the cited applications.

Zener Diodes

The simplest device that can be used for voltage regulation, and hence also for some reference applications, is the lowly zener diode. Figure 1 shows the circuit symbol (inset) and transfer characteristic curve for a zener diode. The diode is little more than a special *pn* junction diode, so will behave like any other *pn* diode in the forward bias region (+V). When the applied voltage is positive, a forward current (+I) will flow. Below a certain threshold voltage (V_g), current is the reverse leakage current (I_r). Above this threshold, however, forward current increases in a linear manner.

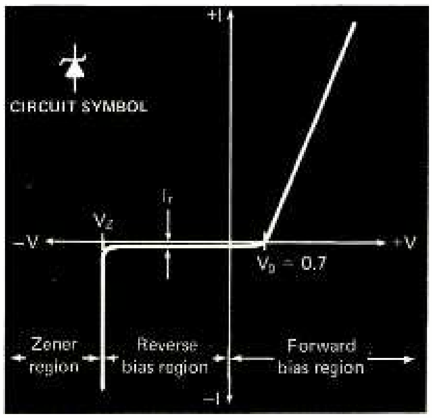


Fig. 1. The characteristic curve of a zener diode. Note very sharp bend at the beginning of the zener region.

In the reverse-bias region, conditions are a little different from ordinary *pn* junction diodes. Leakage current is all that flows for applied voltages (−V) of 0 to V_Z, but when V_Z is reached the diode avalanches. In this condition, the diode will regulate the applied voltage to the value of V_Z.

The basic zener regulator circuit is shown in Fig. 2. This circuit is not used directly as a reference supply, but is included here because it forms the basis of such supplies. Zener diode *D1* is in parallel across load *RL*. Series resistor *R1* limits the current to a safe value (recall from Fig. 1 that −I increases dramatically at V_Z). The output voltage will be regulated to $+V_Z$ in this circuit.

There are some problems with the basic zener diode, which become especially acute when it is used as a reference source. (Remember, "reference" implies accuracy.) First, the voltage specification is only nominal. In other words, a 6.8-volt zener produces a voltage close to—but not necessarily exactly—6.8 volts dc. Another problem is that the voltage drifts somewhat with temperature, hardly a characteristic desired in a reference supply.

Figure 3A shows one crude attempt at stabilizing the temperature-drift problem. In this circuit, a number of zener diodes are connected in a series-parallel arrangement. Each series string produces a voltage drop (V1 and V2), so the differential output voltage is V1 − V2). The idea here is that all diodes, assuming they are identical and in the same thermal environment, will drift the same amount so that the differential effects of drift are zero.

A superior idea is shown in Fig. 3B. The regulator shown here is the National Semiconductor LM-199 (or LM-399) device. It consists of a 6.95-volt zener diode embedded in an electrical heater. (One source told me that the heater was little more than a class-A amplifier with the input shorted, with the zener built on the same substrate to share the thermal environment.) The heater keeps the diode at a constant temperature that is somewhat above ambient room

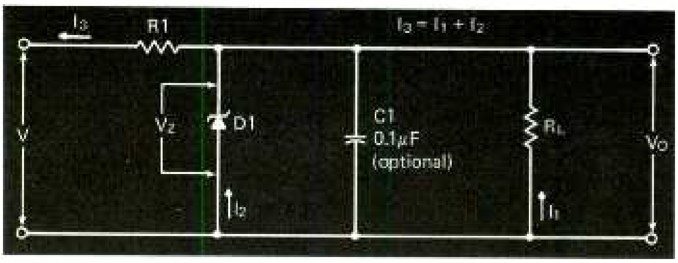


Fig. 2. The basic zener regulator circuit.

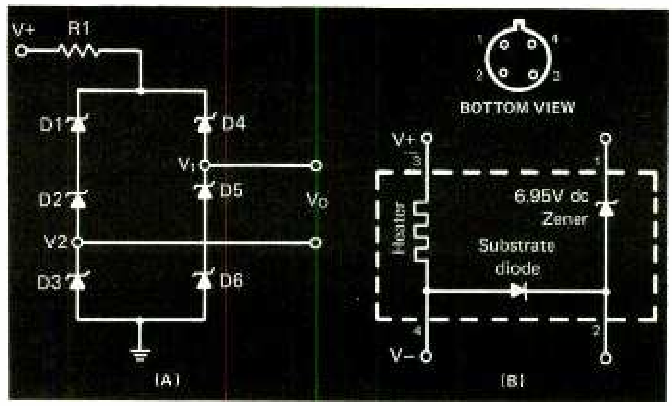


Fig. 3. Crude attempts to stabilize temperature drift (A) have given way to the superior LM339 approach (B).

temperature. With the temperature constant, the diode voltage drop will not drift. The LM-199/ LM-399 offer some startling voltage-drift specifications. There are also other (similar) devices on the market.

Op-Amp Reference Source

Even the LM-199 produces only a nominal output voltage. While that voltage remains constant, it may not be exactly the rated 6.95 volts. The circuit in Fig. 4 can be used to adjust the voltage to any desired value within reason and make it precise. In addition, the operational amplifier buffers the reference supply against changes in load conditions.

The basic circuit of Fig. 4 is the noninverting follower with a gain op-amp configuration. The LM-199 is used to supply the input voltage on pin 3; so the output voltage will be $V_O = V_Z [(R2/R1) + 1]$.

Selection of appropriate values for *R2* and *R1* will produce the desired output voltage. If *R1* is 1000 ohms, a 10.00-volt power supply can be made if *R2* is 438.8 ohms. In most cases, *R2* will be a combination of a fixed resistor (low temperature coefficient) and multi-turn trimmer potentiometer. The trimpot is adjusted for the desired output voltage.

Intersil's ICL-8069

Another form of simple reference source is the Intersil ICL8069 band-

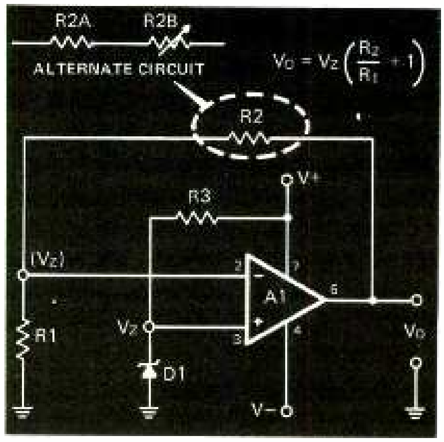


Fig. 4. Noninverting op-amp follower provides means for adjusting precise output voltage from an LM339.

gap zener device, shown in Fig. 5A. This device is a 1.2-volt temperature-compensated zener diode that is designed to operate with low noise at zener currents down to 50 μA. There are several versions of the device, differing mostly in stability and accuracy specifications.

Figure 5A shows the basic circuit for this diode. Note that an output potentiometer is used to pick off the correct voltage from the 1.2 volts available open-terminal. The same circuit is shown in Fig. 5B, with the difference that a fixed resistor is added in series with the potentiometer so that the resolution of the circuit can be increased. The potentiometer selects a potential over a narrower range of total resistance.

Neither of the circuits in Fig. 5 offers the same benefits as the operational-amplifier circuit. Both the earlier op-amp circuit and the circuit of Fig. 6 can be used to overcome some of the limitations of the simpler circuit. In Fig. 6, we see an operational amplifier used in a slightly unusual configuration to produce an output of 10.000 volts, adjustable with *R3*. The operational amplifier's gain is set by the resistance of the potentiometer.

Although an LM-308 is used for the operational amplifier in Fig. 6, almost any quality op-amp could be used. I recommend against using the 751, however, because its drift might tend to decrease the accuracy of the output voltage over time.

In all operational-amplifier circuits, incidentally, it is desirable to keep the op amp itself from drifting. In most cases, this means that the power supply voltages (V − and V +) must be kept as close as feasible to the output voltage being used. This means you must know how close to the supply voltage the output voltage will rise. In some op amps, it is several volts (as low as 0.5 volt in BiMOS devices). In one popular unit, the output voltage can rise to within 1.4 volts of the power supply voltage. For a 10.00-volt reference supply, therefore, we would want to use a standard power supply voltage close to (10.00 + 1.4 = 11.4) volts. In that

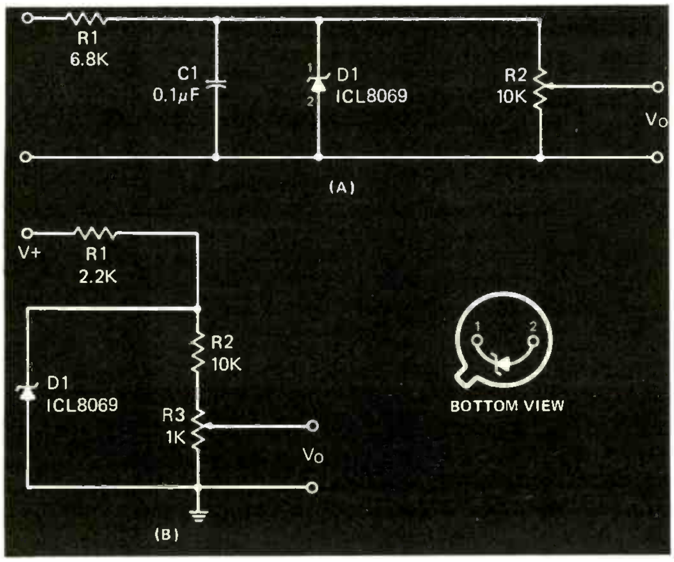


Fig. 5. The basic circuit for the band-gap zener diode in (A) is shown slightly modified in circuit (B).

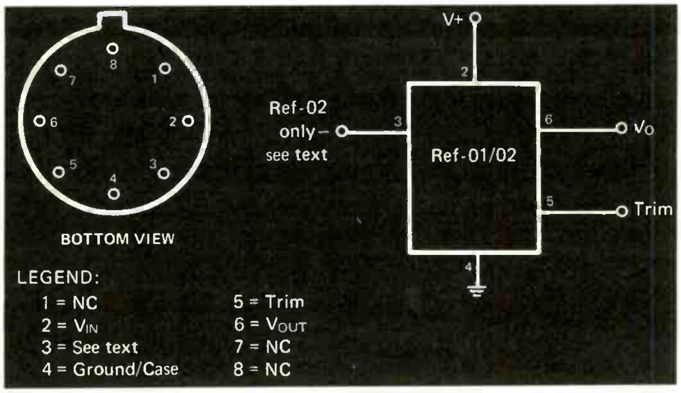
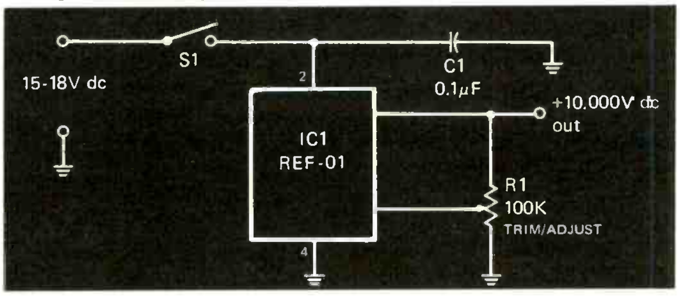


Fig. 7. Drawings show pinouts, case configuration and pin designations of REF-01 and -02 reference devices.

Fig. 8. Usual operating circuit for the REF-01 and -02



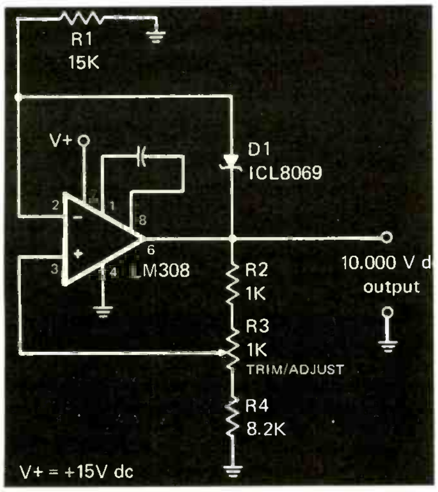


Fig. 6. Using an op amp, exact 10-volt output can be obtained, adjustable with trimmer potentiometer R3.

case, use − 12 volts for V − and + 12 volts for V + .

IC Reference Sources

A very popular device for use in reference supplies is the integrated-circuit reference supply. Although there are many different types on the market, we will use the Precision Monolithics REF-01 and REF-02 devices as our example (see Fig. 7).

The REF-2 is a + 5.00-volt reference source, while the REF-01 is a 10.000-volt unit. Both REF-01 and REF-02 are packaged in an 8-pin metal IC can and use the pin-out definitions shown in Fig. 7. Supply voltage is applied across pins 2 and 4, while output voltage is taken from across pins 6 and 4 (pin 4 is common/ground). Pin 5 is used as a trimmer/adjust input.

The REF-02 uses pin 3 in a unique manner; it is an electronic thermometer transducer. The voltage at pin 3 will have a value of 2.1 millivolts per degree Kelvin ambient temperature. It can be used to form an electronic thermometer.

Figure 8 shows the usual operating circuit for the REF-01 and REF-02 devices. The trimmer circuit consists of a linear-taper potentiometer that selects a sample of the output voltage and inputs it to the trim circuit. This should be a multi-turn pot in order to closely set the output voltage.

I've used the REF-01 device in a number of projects, and found it more than satisfactory. It seems to have even better temperature stability when a Wakefield flexible IC (or TO-5 transistor) heat sink is used on the IC case. Also, keep the input voltage to a minimum required to obtain the output voltage. I have used + 12 volts for the REF-01 and + 9 volts for the REF-02.

A precision voltage-reference source can be built using a simple zener diode-like device, such as the LM-199 or ICL-8069, or a more complex circuit in which an zener diode is used with an operational amplifier. You can also use a special IC reference device, such as the REF-02 by PMI (or one of the equivalents by

(Continued on page 100)

A Universal Rear End

This simple op-amp circuit gives frequently overlooked attention to the outputs of your projects

By Joseph J. Carr

One of the major failings of hobbyist-designed projects, and not a few supposedly professionally designed instruments, is inadequate attention to the rear-end circuitry. In most instruments, the really neat circuits are in the front end. So by the time you get to the rear end, you think of it as just the output section and, thus, don't give it much consideration. But proper design of the back end of an electronic instrument/control circuit can spell the difference between ho-hum operation and a really useful project.

In this article, we'll explore how to build a "Universal Rear End" you can actually use in your designs.

Terminology

Before we begin, let's get a little terminology straight by defining what is meant by the terms "front end" and "rear end." In electronics parlance, the front end of an instrument or other device is the section where input signals are received. Typical examples of front ends are the r-f amplifier in a communications receiver, a transducer amplifier in a temperature monitor, and the differential amplifier in an ECG (electrocardiogram) amplifier or Wheatstone bridge transducer circuit. Almost all signal processing and shaping are performed in the so-called front end.

Though less glamorous than the front end, the rear end is nevertheless very important in overall instrument and project design. By definition, the rear end is the section that contains the output stage(s).

About The Circuit

Shown in the schematic diagram is a semi-universal rear-end circuit I've used professfionally in numerous cases. I've built this circuit into physiological (biopotential) amplifiers, transducer amplifiers, and numerous other projects. The circuit has several very useful features: it has (1) gain when *R2* is greater than 10,000 ohms (otherwise gain is unity); (2) a gain control with a range of 0 to 1 or 0 to A_v; (3) a dc balance control/offset null; and 4) a position control.

The circuit is built around two 1458 operational amplifiers, each of which contains a pair of 741-family op amps in an 8-pin miniDIP package. Any other standard op amp will also work here, though use of the 1458 has the advantage ofreducing parts count and wiring times.

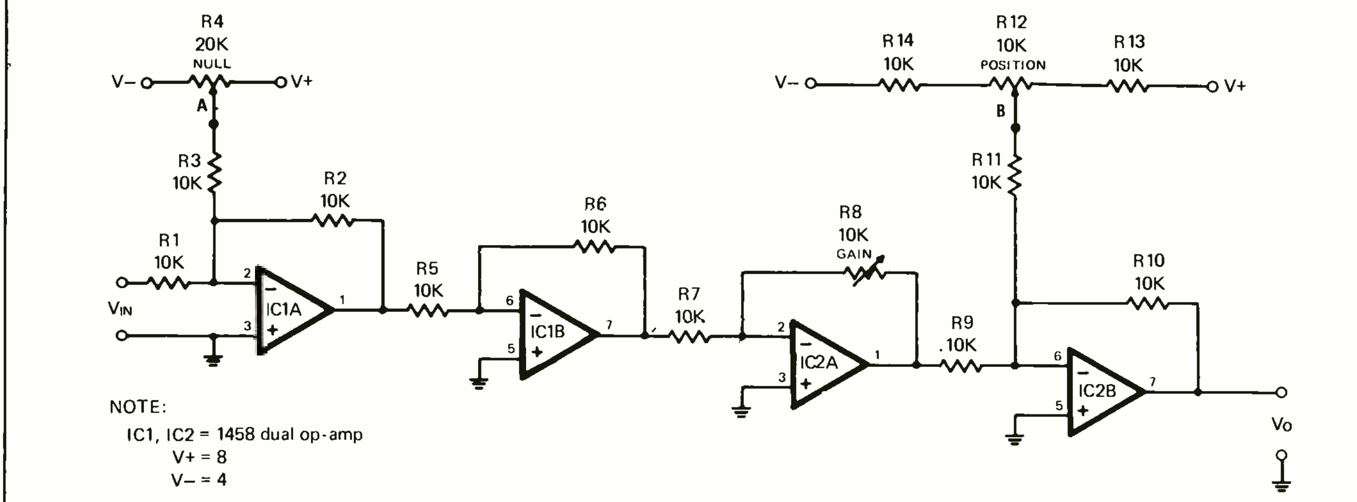
Power for this circuit must be from a bipolar source that delivers both positive-to-ground (V+) and negative-to-ground (V−) dc. Potentials between ±4.5 and ±15 volts dc will serve nicely.

The circuit in the schematic diagram consists of four inverting followers in cascade. As arranged, it serves overall as a noninverting follower. Removing any one on stage (*IC1B* recommended) will make the circuit into an inverting follower, since there would be an odd number of inverting stages.

The gain of an inverting follower operational amplifier stage is set by the ratio of the feedback and input resistors. For example, the gain of stage *IC1A* is −*R2/R1*, where the negative sign indicates that inversion (180-degree phase reversal) is taking place. Similarly, the gain of *IC1B* is −*R6/R5;* of *IC2A*, −*R8/R7*; and of *IC2B*, −*R10/R9*. Overall gain for the entire circuit is simply the product of all the individual gains, or $A_{vt} = A_{V1} \times A_{V2} \times A_{V3} \times A_{V4}$.

Since all gains in the circuit shown are unity, overall gain is one. However, you can increase or decrease the overall gain by varying individual stage gains. The recommended procedure is to vary the gain of fixed stage *IC1B*. In this case, you can assume that the gain of the overall circuit will be −*R6/R5*. Leave *R5*'s value at 10,000 ohms in most cases, unless it's impossible to find a value for *R6* that will result in the correct gain without modifying the value of *R5*. In any event, don't let the value of *R5* become less than 100 ohms. The rules for changing the gain are: 1) unity gain: leave as is (*R5* = *R6* = 10,000 ohms); for less than unity gain, *R5* is greater than *R6* (e.g. if *R5* = 10,000 ohms and *R6* = 2000 ohms, gain is 2,000/10,000 or 0.20); 3) for greater than unity gain, *R5* is less than *R6* (e.g. if *R5* = 10,000 ohms and *R6* = 100,000 ohms, gain is 100/10 = 10).

Gain control *R8* is used to vary overall gain of the circuit from zero to full. If the values are as shown in the schematic, *R8* varies the gain from 0 to 1. This potentiometer is usually a front panel control and is accessible to the user of the project.



PARTS LIST

IC1, IC2—1458 dual op amp (see text)
R1, R2, R3, R5, R6, R7, R9, R10, R11—10,000-ohm, ¼-watt, 10% tolerance resistor
R4—20,000-ohm, linear-taper potentiometer
R6, R12—10,000-ohm, linear-taper potentiometer
R13, R14—See text
Misc.—Printed-circuit board or perforated board with solder posts; 8-pin DIP sockets (2); control knobs (3); input, output, and power connectors; suitable enclosure; machine hardware; hookup wire; solder; etc.

Null control *R4* is used to cancel the effects of dc offsets created both in this circuit and in previous stages. It also provides the dc balance effect noted earlier. The dc balance controls on some instruments are used to cancel the change of output baseline as the sensitivity control is varied—a most disturbing effect to someone making a measurement! Potentiometer *R4* is adjusted using a dc output meter at V_o, and is adjusted until there's no shift in dc output when *R8* is varied through its full range. If there are dc offsets present in the input signal (V_{in}), there will be such a shift noted in the output.

The function of *R4* is to provide an equal but opposite polarity offset signal to cancel the offset from all other sources. In some cases, there might be 10,000-ohm resistors (similar to *R13* and *R14* near *R12*) between the end of the potentiometer and the power supply potentials. These resistors reduce the offset range, while increasing the resolution of the adjustment. Use these resistors only if there's a problem in homing in on the correct value.

Position control *R12* is optional. It's normally used when the output signal is to be displayed on an analog paper chart recorder or dc CRT oscilloscope. Poteniometer *R12* provides an intentional offset to final stage *IC2B* independent of the input signal. It's used to position the output waveform anywhere on the scope's or chart recorder's vertical axis.

In some cases, the range of the *R12* may be too great. Only a small adjustment of the potentiometer will send the trace off-screen. You can counteract this problem with the simple expedient of selecting values for *R13* and *R14* (note that *R13* = *R14*) that allow the trace to just disappear off the top when the *R12* reaches the limit of its upward travel and off the bottom when the potentiometer reaches its lower limit.

Adjustment

Adjustment of this circuit requires either a dc voltmeter or a dc-coupled oscilloscope that has a scale grid on the screen or graticule to permit potentials to be read. If an oscilloscope is used for that purpose (set the switch to GND in AC/GND/DC arrangements), and set the trace to exactly the center of the vertical lines on the grid. Select a sweep speed that yields a nonflickering line. Next, place the switch into the DC position. The vertical deflection factor should be around 0.5 volt/vision.

Now, follow this procedure:

(1) Disconnect Vin from the front-end circuit and short this input to ground;

(2) Using a dc voltmenter, set the potential at point "A" to 0.00 volt;

(3) Similarly, set the potential at point "B" to 0.00 volt;

(4) Set *R8* to maximum resistance (highest gain);

(5) Make all adjustments to the front-end circuits as needed and then return to the rear-end circuit;

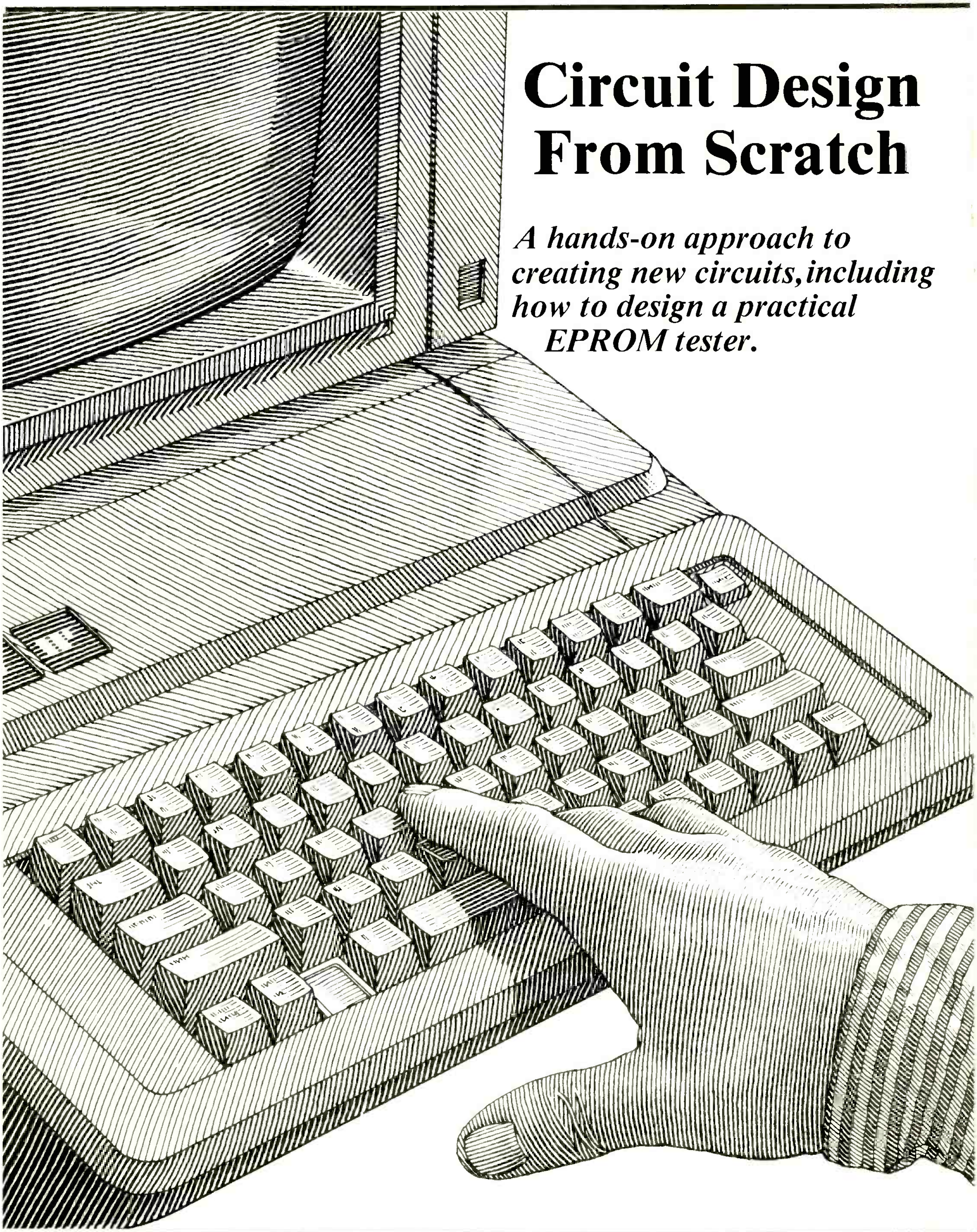
(6) Adjust *R8* through its range

from 0 to 10,000 ohms several times while monitoring scope or meter connected to the output. If the output potential shifts, adjust *R4* until the shift is canceled. You'll have to continually run *R8* through its range while adjusting *R4*. Because this adjustment is somewhat interactive, try it several times, or until no further improvement is attainable.

(7) Check the range of the position control.

In Closing

The universal rear-end circuit is a simple project that can give your instrument and control projects that final "professional" touch that makes them more useful to you and anyone else who uses them. **ME**



Circuit Design From Scratch

A hands-on approach to creating new circuits, including how to design a practical EPROM tester.

By Jules H. Gilder

In the last two installments of this series, we dealt with projects for the home and car. This month, we're going to move into another area of growing interest to electronics enthusiasts. We're going to design a project that will be useful to computer buffs, as well as the advanced electronics hobbyist. The project is an EPROM tester that can be used to determine if an EPROM is completely erased prior to programming.

Most EPROM programmers, whether stand-alone or on boards that plug into computers, will check an EPROM to determine if it is blank before attempting to program it. This may be okay with you if you don't mind tying up your computer, but for practical purposes a portable, battery-powered tester is the better choice. Not only will if free up your computer to do other things, but a dedicated tester can work much faster than a computer can.

The specifications for this project are very simple. We want:

1) a battery-powered tester
2) simple pushbutton operation
3) an indicator to light when an EPROM being tested is not blank
4) the ability to test a device in about one second
5) a tester that will accommodate 2716 and 2732 EPROMS, which are the most popular types now in use.

The requirements don't appear to be too demanding in terms of design effort, but before we can actually design the tester, we must know something about how EPROMs work.

1) How EPROMs Work

Perhaps the best way to gain an understanding of how EPROMS work is to take a close look as the data sheets for the 2716 and 2732. (Data sheets are usually available for the asking from any store or company that sells the device.)

From the data sheet, the first thing we learn is that the chip is powered by a 5-volt source, which means our tester is going to have to contain a 5-volt power supply. Next, looking at the pin configurations (commonly called pinouts) for both the 2716 and 2732 (Fig. 1), we discover that the only difference between the two devices is in regard to pin 21. On the 2732, this pin is used to address the extra memory on the chip. So if we're going to accommodate both chips, we must design in a switch to toggle the connection to this pin.

Another bit of information we glean from the data sheets is that if we want to read data from the 2716, pin 21 must be at +5 volts. On the 2732, however, pin 21 is used as an address pin and, therefore, must be connected to whatever device we use to supply the address to the EPROM. Hence, a single-pole, double-throw (spdt) switch will be needed.

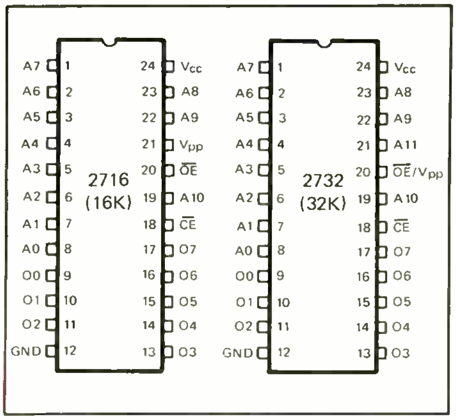


Fig. 1. Pin identification drawings for standard 16K and 32K EPROMs.

How To Read Memory. Before we go much further, it would be easier for us to understand how to design our tester if we understood how data is read from memory chips. Basically, a memory chip is an array of storage locations that can contain information for later use. In RAM (random-access memory), information in memory can be altered at will. (By the way, the term "random-access memory" is a misnomer, because even ROMs and EPROMs are random-access devices. Any byte in any of these devices can be directly accessed. Therefore, a more proper term for the RAM would be R/WM, for read/write memory).

In the ROM (read-only memory), once information is stored, it cannot be changed. In the EPROM (electrically programmable read-only memory), information can be stored in memory and when no longer needed be erased to ready it for entry of new information. The difference between RAM and EPROM memory is that a RAM can be erased and have new data entered into it immediately with electrical signals. RAMs also lose their data when power is removed from them and, consequently, are called *volatile* memory. EPROMs, on the other hand, must be erased by exposing them to intense ultraviolet light for about a half hour. Only then can they be rewritten and then only with a higher programming voltage. Also, any data programmed into EPROMs remains there even when power is removed, making these devices *nonvolatile* memory.

To be able to look at a particular cell or location in memory, you must tell the chip which memory location you wish to examine. Just as you must tell a friend your address if you want him to visit you, you must tell the memory chip the address of the location you wish to examine.

In the case of computer memory devices, the address of the cell being referenced is designated by a series of bits. There is a pin connection on the memory chip for each address bit (location). A *bit* represents the smallest piece of digital information and can have only one of two possible states —on or off, high or low, true or false, etc. Since a bit represents only two possible states, it's also referred to as a Binary digIT, from whence the contraction "bit" is derived. A bit can

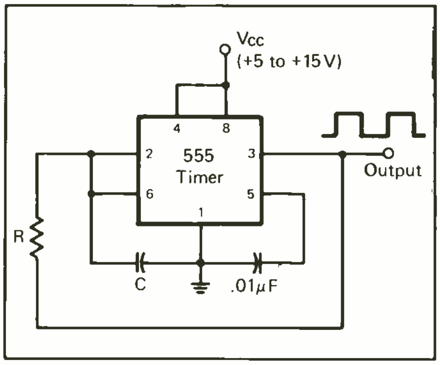


Fig. 2. Just three external components turn a 555 timer IC into an oscillator that services as a clock.

have a value of either a 0 or 1. Combining eight bits into a single entity yields a *byte*.

Numbers can be represented by a combination of bits. For example, two bits can represent any number between 0 and 3, while eight bits (one byte) can represent any number between 0 and 255 and 16 bits (two bytes) can represent any number between 0 and 65,535.

Memory devices can be organized in a variety of ways. For example, it's possible to have a 16K-bit device organized as 16,384 locations, each of which is one bit long, or as 2048 locations, each of which is eight bits (one-byte) long. The second approach is used to organize the memory in the 2716, while the 2732 is organized into 4096 by 8 bits.

Knowing the organization of the chips we're going to be testing, we can see that our tester will be required to access either 2K or 4K of memory. To access 2K, we'll have to know how many binary digits are required to represent 2K numercially. That number of digits is the same number of address lines we'll need. To represent 2048, the actual figure represented by the 2K shorthand commonly used in computing, we must have 11 address lines for the 2K by 8 EPROM. From Fig. 1, we see that the 2716 meets the requirement with the 11 address lines labeled A0 through A10. Similarly, the 2732 would need 12 address lines, which it has, labeled A0 through A11.

One more thing about memory devices and we should have their operation down pat. Whenever an address is placed on the address lines of a memory device, the contents of the cell at that address are automatically placed on the data (output) lines. Thus, as the address changes, the data on the output lines changes with it. Since the chip is organized as 2K by 8 bits, there must be eight data output lines. We can see in Fig. 1 that these lines are present in both the 2716 and 2732, labeled O0 through O7 (sometimes also represented by the labels D0 through D7).

To produce a device that tests EPROMs to determine whether or not they are blank, we must know what a blank EPROM looks like. This is easy: a blank EPROM has a 1 stored in each location on the device.

Now, if we can figure out a way to constantly change the address applied to the address lines and we check each of the eight output lines to make sure there are indeed 1s, we'll know if an EPROM being tested is blank or not. If even one bit in the EPROM is not a 1, then we don't have a blank device and it is either bad or must be erased.

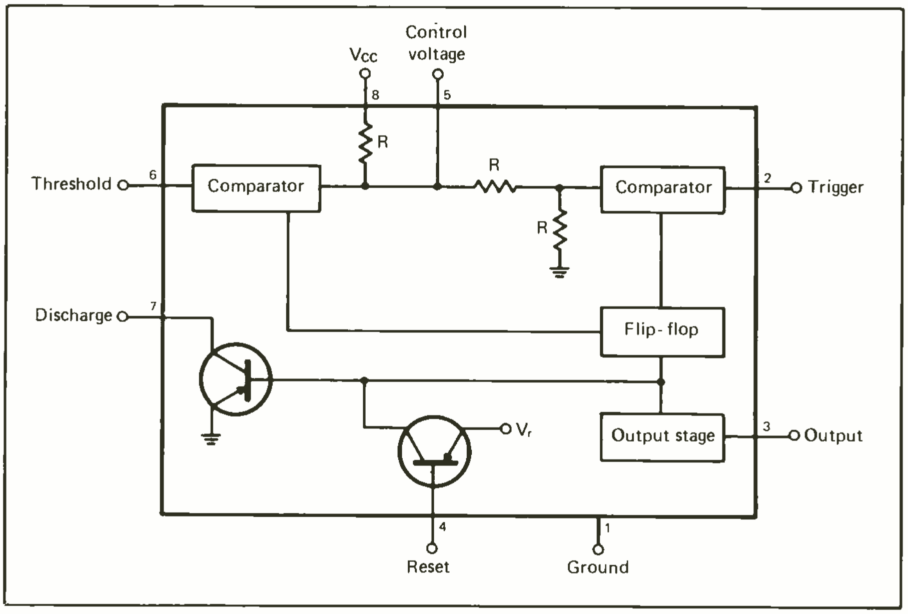
2) Design The Output Line Monitor

Since we're checking to determine if the output lines of an EPROM are all 1s and we want an indication if any of them is not, we should used a NAND gate. From earlier installments in this series, we know that if all inputs to a NAND gate are 1, the output is 0, and if any one or more inputs are 0, the output will be 1. Thus, we need an

Pinout Comparison Chart

Function	555 timer pin No.	556 timer 1 pin No.	556 timer 2 pin No.
ground	1	7	7
trigger	2	6	8
output	3	5	9
reset	4	4	10
control voltage	5	3	11
threshold	6	2	12
discharge	7	1	13
supply voltage	8	14	14

Fig. 3. This drawing illustrates the internal elements of the 555 timer.



8-input NAND gate, such as the 4068 CMOS device.

Connecting each of the data output pins of the EPROM under test to an input of the 4068, we can check the output of this gate to determine if and when it goes high. If the output does go high, we know that there's a bit in the EPROM that has been used.

To insure that the inputs to the gate stay high until a 0 is applied to one of the data lines, "pull-up" resistors are connected to each input and the positive side of the power supply. As long as no 0 is applied to a data line, these resistors will pull the data lines up to the power supply voltage. If a data line has a 0 on it, the side of the resistor connected to the NAND gate goes low, as does the input to the gate.

3) Address The EPROM

Now that we have a way of monitoring the output, we must have a means of applying addresses to the address lines and to change them. To do this, we'll use a *binary ripple counter,* which uses a series of "clock" pulses to advance the count for each pulse applied. Since this is a binary counter, its output is the binary equivalent of the number of pulses applied. If we connect the binary outputs to the address lines of the EPROM and then apply a clock signal that constantly increments the binary output of the ripple counter, we've found a way to change the address of the EPROMs as required.

Since we need 12 bits to address all memory in the 2732, we need a 12-stage binary ripple counter to supply the addresses for our EPROM. Going through a list of CMOS devices (or Don Lancaster's very handy *CMOS Cookbook* from Howard W. Sams), we find that the 4040 CMOS IC is exactly what we need.

The 4040 uses a clock input to produce a count, on 12 separate output lines, that represents the binary equivalent of the number of pulses applied. When the count exceeds 4096, the outputs return to 0 and counting starts over. Thus, with a continuous stream of pulses, the addresses in the EPROM will be continuously and cyclically addressed.

4) Design The Clock Oscillator

Using the 4068 and 4040, we've accomplished the bulk of the design work required for this project. Only a few things remain to be done. Firstly, we need a source of clock pulses to drive the binary counter. Secondly, we need some means of indicating when a bad or nonblank EPROM is encountered.

One of the easiest devices to use for a clock oscillator is the 555 timer IC. The circuit for this and many other useful projects can be found in my book *110 IC Timer Projects* (Hayden Book Co.). Using this IC and only one resistor and capacitor, it's possible to assemble an oscillator (Fig. 2) whose frequency is determined by the formula $F_0 = 0.772/RC$, where F_0 is in Hz if R is in megohms and C is in microfarads.

Figure 2 specifies a 0.01-μF capacitor connected to pin 5 of the IC. While this isn't really needed and the circuit will work without it, it does provide some noise immunity for the circuit, and good design practices dictate that it should be included.

In operation, the output of the Fig. 2 oscillator at pin 3 of the 555 is initially high and the timing capacitor starts charging exponentially at a time constant of RC. When the voltage across the capacitor reaches 0.67 of the value of the supply voltage (the upper threshold), a voltage comparator built into the 555 triggers an internal flip-flop (Fig. 3) and the potential on pin 3 drops close to 0 volt. The capacitor starts to discharge exponentially with a time constant of RC.

When the voltage across the capacitor reaches 0.33 of the value of the supply voltage (the lower threshold), a second internal voltage comparator triggers the 555's internal flip-flop and the output of the IC at pin 3 goes high once again.

The result of this back-and-forth charging and discharging is a series of pulses at pin 3 of the 555 timer IC.

The time in seconds it takes for the charge on the capacitor to reach the upper or lower threshold is 0.693RC (R is in megohms and C is in microfarads). A complete charge/discharge cycle is simply twice this time, or 1.386RC. The frequency of the pulses produced is the inverse of the time it takes for one complete charge/discharge cycle, or 0.722/RC.

With such a simple circuit and design formula, determining component values shouldn't be difficult. The first thing we must decide is at what frequency we want the clock to operate. We want to test an EPROM in less than a second. If a 2732 is used, we must check 4096 memory locations. To check this many locations in one second, we'd need a clock with a frequency of 4096 Hz. To check 4096 locations in 0.5 second, the clock frequency would have to be 8192 Hz. Though this would be perfectly acceptable, I preferred to use a 0.33-second test time, which requires a clock frequency of around 12,000 Hz (12 kHz).

Plugging 12 kHz into our formula and solving for RC, we obtain $0.722/12{,}000 = 60 \times 10^{-6}$. Any combination of resistance and capacitance that produces this time constant is acceptable, but a few details must be borne in mind. Resistor values should be kept to less than 1 megohm whenever possible so that a decent amount of current will flow, and capacitance should be kept to less than 1 μF if possible to avoid having to use high-leakage electrolytics.

Since 10,000-ohm resistors are used elsewhere in the project and there would be fewer components to keep track of, let's see if we can use a 10,000-ohm resistor here, too. The decision-making process in this case is as arbitrary as that. If $R = 10{,}000$ ohms, C would have to be 60.2 nF. Using a much more common 50-nF capacitor, however, we find that the frequency becomes 14.4 kHz, which is a little higher than the 12 kHz we wanted but still perfectly acceptable.

5) Design The Output Indicator

Although a high clock frequency will permit quick testing of EPROMs, if an EPROM has only one bad bit in it, you'll have only about 70 microseconds (1/14,000) to see it. This is obviously not going to be feasible. So, to overcome this, we're going to "stretch" the pulse to make it long enough in duration to light a LED and provide a visual indication.

Stretching of short-duration pulses is common in digital circuits, accomplished with a special circuit known as a *monostable multivibrator.* A pulse of any duration applied to the input of a monostable multivibrator generates an output pulse also of any duration. The only limitation is that the input pulse must be shorter in duration than the output pulse.

For our monostable multivibrator, we once again call on the versatile 555 timer. While the normal monostable operating mode of the 555 requires that the input pulse be negative (from a positive voltage momentarily to a negative or zero voltage and back), it's possible to use positive pulses, such as the one generated by the 4068 in our circuit, to trigger the monostable multivibrator (Fig. 4).

When the circuit is first activated, the trigger input to pin 6 (the output of the 4068) is low, timing capacitor *C* is discharged, and pin 2 is momentarily held low. This causes the internal flip-flop to switch state and forces the output at pin 3 to go high. With the output high, *C* charges to a value near the supply voltage and stays there.

When a trigger pulse of an amplitude greater than 0.33 of the supply voltage is applied to pin 6 (this is the pulse produced by the 4068 when a "bad" bit is encountered), the internal flip-flop is activated once again

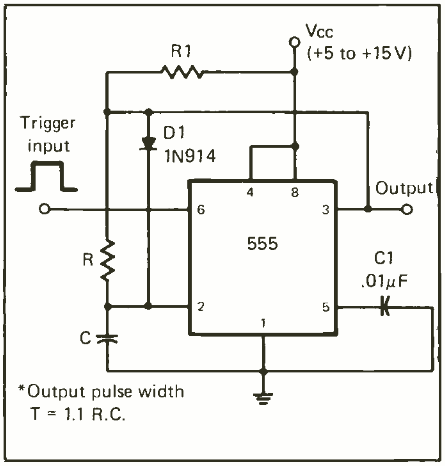


Fig. 4. Here the 555 timer is used as a monostable multivibrator.

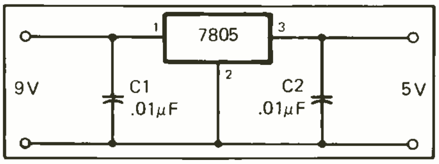


Fig. 5. A 7805 regulator outputs 5 volts from a 9-volt battery source.

and the output at pin 3 is forced low. This effectively grounds the point between *R1* and *R,* allowing *C* to start discharging through *R* to ground.

Discharge of *C* continues until the voltage on *C* and pin 2 of the IC reaches 0.33 of the supply voltage. When it does, the internal voltage comparator connected to pin 2 causes the flip-flop to switch again and *C* is quickly recharged via *R1* and the diode. The width of the pulse produced is 1.1RC.

We want to easily see even a single pulse out of the 4096 that will be used to test the EPROM. Therefore, if we stretch the pulse so that its width is as long as the time it takes to test the EPROM, even a single bad bit will cause the output to remain high all the time. Thus, we want a pulse width of roughly 0.33 second. You simply divide by the 1.1 in the formula to obtain RC = 0.3 second.

Arbitrarily selecting a 10-μF value for *C,* we find that *R* must have a value of 30,000 ohms. Although we could use 10 μF and 30,000 ohms, we'll opt for a standard value resistor as close to 30,000 ohms as we can get, which is 27,000 ohms. Using this value with the 10-μF capacitor, we obtain a pulse width of 0.297 second. This is close enough to what we originally wanted.

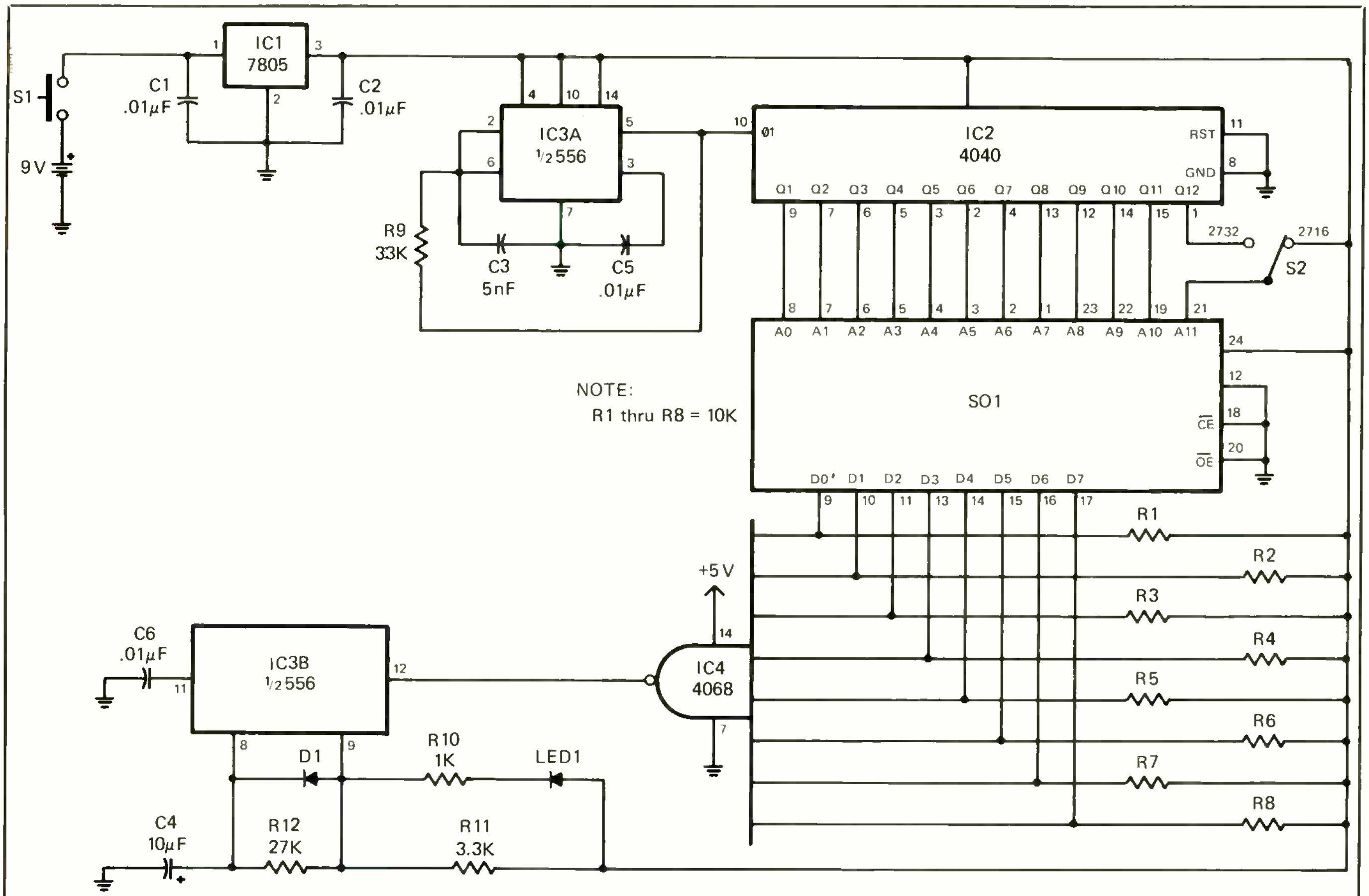
The positive-triggered monostable multivibrator produces a negative pulse. That is, its output is normally high and goes low only when the device is triggered but returns to a high state. The 555 timer can supply enough current to directly drive a LED. Therefore, if we connect a LED (and appropriate current-limiting resistor) between the positive-voltage power supply line and the output of the timer at pin 3, we'll have a visual indicator that tells us when an EPROM isn't blank.

When the monostable multivibrator isn't triggered, the voltage on both sides of the LED is essentially the same and no current flows. Triggering the monostable multivibrator causes the device's output to go low, essentially grounding the cathode side of the LED to complete the current path and turning on the LED. Once again, a capacitor is used to bypass pin 5 to ground to provide noise immunity for the circuit.

Since both the oscillator and the monostable multivibrator use 555 timers, we could build the circuit with two 555s. However, we can simplify the construction phase of the project by using a dual 555 timer device, known as the 556 dual timer. The timers in both devices are essentially identical, but since two timers are built into the 556's package, adjustments must be made in pin designations to assure a properly operating circuit. The pinouts for the two devices are enumerated in the Table.

6) Designing The Power Supply

Our design is nearly complete. All we have to do now is take care of one



PARTS LIST

Solid-state devices
D1—1N914 diode
IC1—7805 5-volt regulator
IC2—4040 CMOS 12-stage binary ripple counter
IC3—556 dual timer
IC4—4068 CMOS 8-input NAND gate
LED1—Light-emitting diode

Capacitors
C1,C2,C5,C6—0.01-μF disc
C3—5-nF disc
C4—10-μF, 15-volt electrolytic

Resistors (¼-watt, 10%)
R1 thru R9—10,000 ohms
R10—1000 ohms
R11—3300 ohms
R12—27,000 ohms

Miscellaneous
B1—9-volt transistor battery
S1—Normally-open, momentary-action spst pushbutton switch
S2—Spdt slide or toggle switch
SO1—24-pin ZIF (zero-insertion-force) socket for testing EPROMs

Sockets for ICs; suitable enclosure; printed-circuit board; terminal clip for B1; holder for B1; machine hardware; hookup wire; solder; etc.

Note: The following items are available from Redlig System, Inc., 2068 79 St., Brooklyn, NY 11214; printed-circuit board for $15; complete kit of parts (not including battery, case, EPROM, or ZIF socket) for $25.

Fig. 6. This is the overall schematic of the EPROM tester. EPROMs to be tested plug into SO1, which should be a zero-insertion-force socket. Tests are initiated by pressing S1; LED1 serves as a good/bad indicator.

minor detail—the power supply. While the 556 and CMOS ICs will operate over a broad range of voltages, the EPROMs themselves require a power supply capable of delivering a stable 5 volts. To make things simple, we'll power the whole thing from a 5-volt supply.

Since 5 volts isn't easily available from batteries, we'll use a common 9-volt battery. With a voltage-regulator IC, this is the simplest part of our project's design.

Our choice of regulator here is the 7805. This 5-volt regulator is supplied in a three-pin, transistor-like package. To use it, we merely connect the + terminal of the 9-volt battery to pin 1 and the − terminal to pin 2. The 9 volts going into the 7805 emerging as regulated 5 volts at pin 3. The common connection for the en-

(Continued on page 100)

ELECTRONICS NOTEBOOK

Super-Bright LEDs

By Forrest M. Mims III

•n this era of increasingly complex microprocessors and very-large scale memory arrays, it's hard to get excited about a simple component like a light-emitting diode. That's why a few days passed before I got around to evaluating three ordinary-looking LEDS that recently arrived from Lance Kempler, a long-time reader of my columns in this and other electronics magazines.

Lance is with A.C. Interface, Inc., the U.S. company that represents Stanley Electric Co., Ltd., one of Japan's major manufacturers of LEDs and photodetectors. Before sending the sample diodes, Lance had called to say they were on the way and that I'd be a surprised at their brilliance. That prediction turned out to be an understatement. The new LEDs are the most amazing I've seen since first viewing the soft red glow of an early gallium-aresnide-phosphide (GaAsP) red-emitting diode during a visit to Texas Instruments back in 1966.

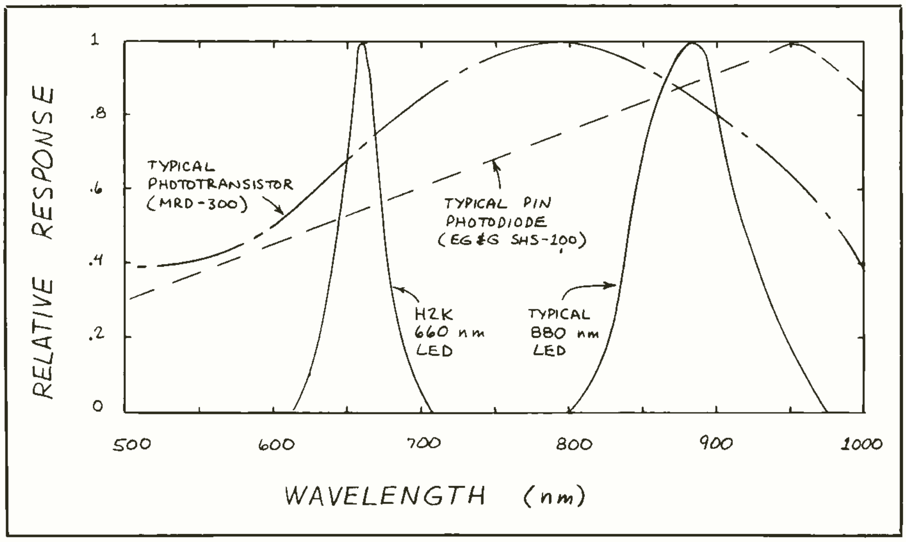


Fig. 1. These plots compare spectrum of the H2K with other LED devices.

Checking It Out

So bright are the new LEDs that when I first tested one there appeared to be a problem with the digital multimeter I used to monitor the current through the diode. When the power supply was cranked up so that the LED was emitting a bright red glow, the multimeter indicated a current of only 3 milliamperes. A normal LED would have required considerably more current than that to achieve a similar level of brightness, so I substituted another meter. But the result was the same. Still not trusting the separate but equal current readings, I determined the current by measuring the voltage across the 100-ohm current limiting resistor in series with the diode and then used Ohm's law to calculate the current ($I = E/R$). The result was still 3 milliamperes.

After making that third measurement, I suddenly remembered Lance's remarks about being surprised and decided to apply a full 50 milliamperes to the diode. The LED emitted such an astonishingly bright beam it was impossible to stare directly into the end of its epoxy lens.

These super-bright LEDs are designated by Stanley as part number H2K. According to the specification sheet Lance sent with the diodes, the H2K is a gallium-aluminum-arsenide (GaAlAs) device that has a brightness of 2000 mcds (millicandelas) when biased with the industry-standard forward current of 20 milliamperes. At 50 milliamperes, the brightness increases linearly to an incredible 4500 mcd.

How bright is 2000 or more mcds? Prior to the arrival of the H2Ks, the brightest red LEDs in my benchstock were some Hewlett-Packard "ultra-bright" HLMP-3750s. According to the HP data sheet, these diodes are made from GaAsP on GaP and have a typical brightness of 140 mcd at 20 milliamperes. In other words, the brightness of the H2K is more than 14 times greater for the same forward current. In fact, at 2 mA forward current, the H2K achieves a brightness of 200 mcd, higher than that of the HP diodes at 10 times the current level.

As might be expected, the new LEDs have an exceptionally high power conversion efficiency. An incandescent lamp transforms into visible light only about 5 percent of the electrical current flowing through a hot filament. The new super-bright LEDs are three times as efficient as incandescent lamps. If not for losses of light caused by internal reflection and reabsorption inside the LED chip and additional losses conributed by the LED package and chip header, the new diodes would posess considerably higher efficiency.

Applications for Super-Bright LEDs

Stanley's new state-of-the-art LEDs are so much brighter than previous devices that several important new applications are made possible. One of the most obvious uses is to form arrays of the new diodes into burnout-proof lights for automobile taillights and traffic signals. When placed behind a plastic diffuser, a single super-bright LED can function as a bicycle taillight. Linear arrays of the new diodes can function as high-brightness light sources for xerographic-style copy machines that also function as computer printers. A warning flasher could be made by connecting one of the new LEDs to a simple pulse generator circuit.

A more sophisticated role for the new LEDs is as a light source for both optical fiber and free-space lightwave communication systems. Low-cost plastic fibers transmit well at the 660-nanometer wavelength emitted by the new LEDs. The optical diodes used in free-space systems are almost always the infrared-emitting variety since they are so much more powerful than conventional red LEDs. However, and this is truly impressive, the new LEDs are just as powerful as most of their infrared-emitting counterparts. Therefore, in applications where a visible beam is acceptable, the new red LEDs will make an excellent alternative.

If you've ever attempted to point the invisible beam from an infrared communicator directly at a distant receiver, you can better appreciate the value of an easily modulated source like an LED that happens to emit a very powerful yet visible beam of light.

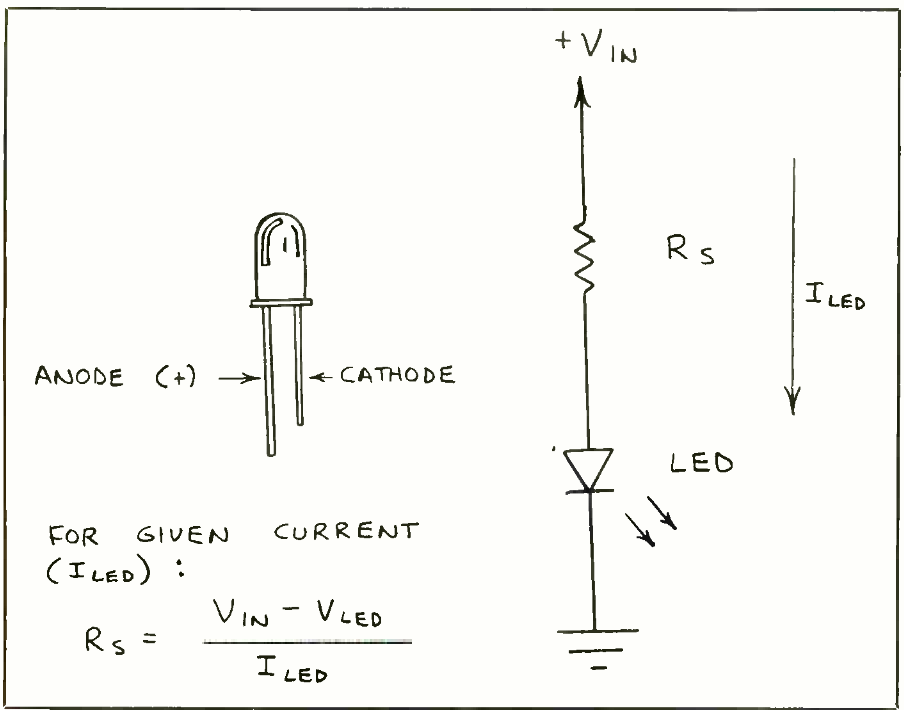
In preliminary tests, the new LEDs perform well as light sensors. Therefore, they can be used as dual-function source-sensors in two-way lightwave links. I have used this method extensively in the design of lightwave communication systems that send and receive information over a single optical fiber.

The features that make the new super LEDs well-suited for lightwave communications are equally desirable for such applications as reflection-mode and break-beam detection systems. The new diodes could also be used in visible-light versions of infrared remote-control units for home appliances and toys.

For applications in which the LED is paired with a sensor, it's important to consider the spectral sensitivity of the sensor. Figure 1, for example, compares the spectral emission of the H2K with the spectral sensitivity of two photodetectors. Some photodiodes have better sensitivity to the 660-nm wavelength of the H2K than the one shown in the figure. Note how the 880-nm near-infrared emitter more closely matches the peak sensitivities of the two photodetectors.

Finally, a number of scientific applications for super-bright LEDs come to mind. For example, since LEDs can be pulsed on and off in tens of nanoseconds, an array of super LEDs could be used to illuminate ultra-fast moving objects in high-speed photography. Another scientific application would be to use a 660-nm super LED in an array with a conventional AlGaAs 880-nm diode and a GaAs: Si 950-nm emitter to quickly measure the reflectance of objects at three distinct optical wavelengths.

Fig. 2. Basic LED drive circuit and formula for calculating R_S value.



Measuring the Power Of Super-Bright LEDs

Prior to trying the sample super-bright H2K LEDs in some simple circuits, I first used a Centralab CSC-12 calibrated silicon solar cell to measure their power output. Figure 2 shows both the basic drive circuit for these tests and the formula for calculating the value of the required current-limiting resistor. The actual tests were made with power supplied by an adjustable supply.

According to a technical paper prepared by scientists from Stanley Electric Co., at a forward current of 20 milliamperes, the typical H2K emits 6 milliwatts. At 50 mA, the typical power output rises to 14 mW. At the 660-nanometer wavelength emitted by the H2K, the CSC-12 detector used to measure the power in the beam from the diodes has a responsivity of 0.42 mA/mW. In other words, for every milliwatt of 660-nm radiation that strikes the detector, an output current of 0.42 milliamperes is produced.

The three sample diodes I tested emitted less power than specified in the Stanley paper. At 50 milliamperes forward current, the measured output power for each diode was: LED 1: 5.55 mW; LED 2: 7.10 mW; LED 3: 5.05 mW.

Each LED was measured within one second after power was applied since the power output falls somewhat as the chip becomes warm. At 50 mA forward current, the minimum specified output for these LEDs is 70% of the typical value of 14 mW, or 9.8 mW, still significantly more than the measured results. Why?

My tests measured only the power contained within the focused beam emerging from the lensed end of the LEDs. However, some light is emitted from the sides and even the base of epoxy-encapsulated LEDs. Manufacturers usually measure the *total* power emitted by an LED by collecting virtually all the radiation with an

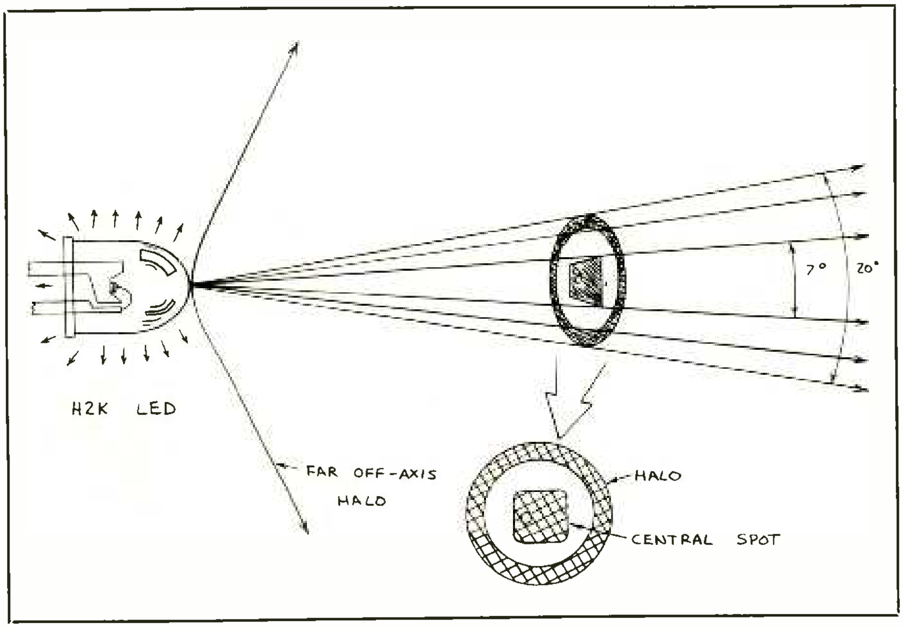


Fig. 3. Details of how author measured the beam profile of the H2K LED.

integrating sphere, a hollow sphere coated on its inside with highly reflective white paint. The LED being measured is inserted in one aperture and a detector is inserted in another. Though the calibrated detector I used collected all the focused beam, it collected none of the off-axis light spilling out the sides of the epoxy package.

In other words, the power within the central beam of the H2K is only about half the total power emitted by the LED. Nevertheless, the power is still substantial. Only a few years ago, the best near-infrared emitting diodes made from GaAs:Si and encapsulated in epoxy much like the H2K were considered good quality devices if at 50 mA forward current their central beam contained 3 mW, only about half the power of the H2Ks I tested. AlGaAs near-infrared 880 nm diodes emit approximately the same power as the red H2K LEDs.

Figure 3 shows the beam pattern emitted by an actual H2K. Like other visible and infrared optical diodes in which the chip is installed within a miniature reflector, the far-field beam structure is a bright central spot surrounded by a somewhat dimmer halo. The central spot is the imaged surface of the LED chip. The dark spot in the center is the point of attachment for the chip's upper lead.

The halo effect is caused by the tiny reflector in which the LED is installed. The reflector captures light emitted from the sides of the chip and reflects it toward the lens formed by the curved end of the epoxy package. Since the reflector is larger that the chip, it is imaged as a halo around the chip. The halo has a broader beam spread or divergence (about 20°) than the chip (only about 7°).

Note that considerable light emitted by the LED is *not* within the central spot and halo. Some is contained within a very broad, off-axis halo that surrounds the central halo and spot. The rest emerges from all sides of the diode's package.

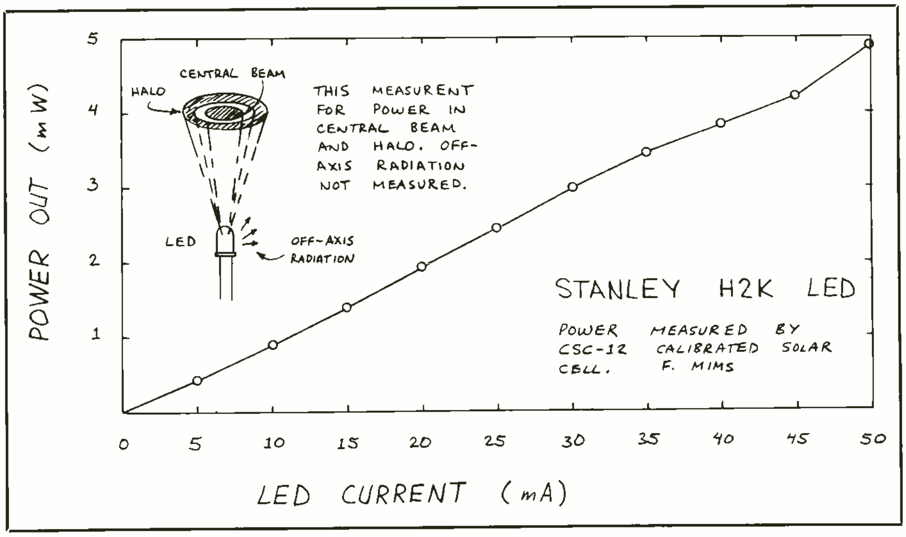
Figure 4 shows the power output of the lowest-powered H2K I measured. For these measurements, continuous power was supplied to the LED. The power output would have been somewhat greater if the measurements were made within a second or two after power was applied.

Super-Bright LED Flasher

Figure 5 shows a an ultra-simple but effective flasher circuit for a super-bright LED like the H2K or similar devices. This circuit flashes approximately 1.5 times per second using the values shown. The flash rate is directly proportional to the value of capacitor *C1*.

For applications in which maximum brillance is not required, *R3* can have a very high value. Since the H2K has a brightness of hundreds of millicandelas at only a few milliamperes forward current, the current drain of the flasher cir-

Fig. 4. Graph plots output power in central beam of H2K super-bright LED.



cuit will be exceedingly low and battery life will be quite long.

Going Further

If you haven't previously worked with LEDs, you can find some basic information about these and other solid-state optoelectronic devices in a book I've written for Radio Shack called *Getting Started in Electronics*. The book also includes some circuits you may wish to try.

For additional information about the H2K and similar super-bright red LEDs, contact Lance Kempler at A.C. Interface, Inc. (17911 Sampson Lane, Huntington Beach, CA 92647). Since the yield of the superbright H2K LED is low, the diode's price is a rather steep $14. The minimum order from A.C. Interface, Inc. is two pieces.

Incidentally, at a time when high-power near-infrared emitting diodes can be purchased for a few dollars or less, the price of the H2K probably seems out of line. On the other hand, old timers can readily remember when very dim red LEDs cost about the same as the H2K. As for near-infrared emitters, the first ones I experimented with back in 1966 cost $365 each! No doubt the price of the H2K device will decrease over time as the yield is improved.

If you want to explore fiber-optic communication applications for super-bright LEDs, Stanley makes the FH511 emitter and FS511 detector. These devices are encapsulated in special flat-ended packages in which the sensing and emitting chips are very close to the surface. Stanley also makes plastic connectors for coupling fiber optics to these devices.

Many other companies also make inexpensive LEDs and detectors designed to be installed within plastic connectors. At the present time, the chief advantage of the Stanley diodes is that their peak wavelength of emission is transmitted well by inexpensive plastic optical fiber.

Though the H2K is one of the most exciting LED developments to occur in some time, other big developments are on the horizon. LED technology was first invented in and extensively developed in the United States long before Japanese companies entered the business. Since the U.S. companies have been making various kinds of powerful GaAlAs near-infrared emitting diodes for more than five years, there should be no fundamental reason why they can't also develop super-bright visible LEDs. Should this development occur, super-bright LEDs will become very cheap.

After several false starts, watch for the eventual availability of the elusive blue LED. Finally, considerable work is underway in several countries in an effort to solve the very difficult problem of reducing to below 700 nanometers the wavelength of continuously operating laser diodes. The objective of making laser diodes that emit at visible red wavelengths is to make them better suited as a readout device for audio and video laser-disk players. Considering the enormous market for laser-disk players, visible-light laser diodes that emit the same power as the H2K LED should one day be quite affordable. The advantage of the laser over the LED, of course, is that the light emitted from a laser can be collimated, by means of a simple convex lens, into a much tighter beam, since it originates from a much smaller point. ME

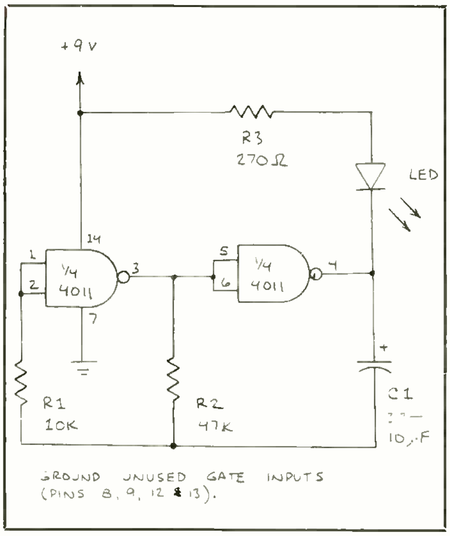


Fig. 5. Flasher circuit for driving a super-bright LED uses a pair of 4011 NAND gates arranged as an oscillator.

HARDWARE HACKER

Instant transfers of programs between most microcomputers, solar energy breakthrough, reducing your home power bill, reset key protector, and more

By Marcia Swampfelder

This month Don Lancaster is off on a Tinaja Quest, so he has asked me to make one of my rare guest appearances. I do have a bunch of stuff of my own on hand, so here goes . . .

* * *

What is a Laterally Compliant Diskette?

The *laterally compliant* diskette is a dramatic new product pioneered by *Gentry Manufacturing.* Complaint diskettes are made of a new and extremely hi-tech elastomeric material that allows them to stretch only and precisely in the radial direction. When properly packaged, a laterally complaint diskette allows instant transfers of program between microcomputers or dino systems having wildly different disk drive sizes.

For instance, Fig. 1 shows one of their first products, The LCDM 8/5. As you can see, the diskette will fit either an 8 inch drive or a 5¼" drive, simply by rotating the package a quarter turn. To download programs from a minicomputer to a microcomputer, all you do is put the LCDM diskette in the 8" drive and save your programs or files to it. Then you rotate the LCDM a quarter turn and put it into your microcomputer's drive, and then transfer the programs and files to a stock 5¼" diskette.

How does it work? There is an oval track inside the envelope. The laterally compliant diskette material goes past the 5¼" read slot in its normal size, and then gets suitably stretched as it goes past the 8" read slot at its maximum width. As you might expect, the track itself is the real breakthrough, since it has to be extremely precise and carefully temperature compensated, without being overly thick.

Several other products for the format transfer are in the beta testing stage. Gentry's LCDM-5-3 is intended for Apple compatibility, letting you freely swap programs and data between an *Apple IIe* and a *Macintosh.* As before, the package is "T" shaped. This one is, of course, smaller, since the normal size is for a Macintosh 3½" drive and the stretched size fits the 5¼" Apple drive.

To fit the smaller 3¼" drive, a small snap-in centering plug is temporarily added. This is remarkably similar to those adaptors sometimes used to let a 45-rpm phonograph record fit a combination 33/45/78-rpm turntable.

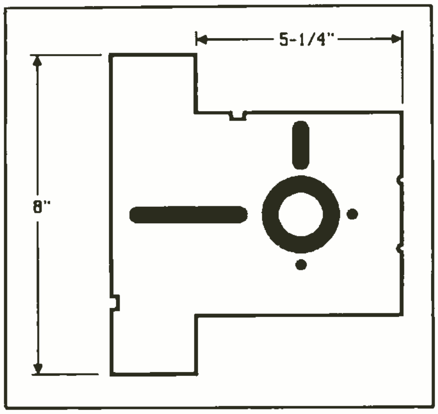


Fig. 1. The LCDM 8"/5¼" disk has a compliant elastomeric recording surface that travels an elliptical path.

Yet a third product is planned to eliminate the squabble over the nonstandard alternates to the *Sony* 3½" mini-disk. This one is more or less rectangular, except that either wall of the envelope can be snapped to any size from 2¾" to 4⅛", in increments of 1/64". A metric version is also available. Clip-on gates and shutters are available to suit the oddball sizes.

For a limited time, Gentry is offering a free evaluation sample of any one of their laterally compliant products. Contact one of their authorized factory representative for full details.

* * *

What is the "In Situ" Solar Cell Process?

That's the big breakthrough in solar cell design that drops the cost of solar power to $90 per kilowatt. Actually, the *in-situ* (Latin for "in-place") technique is stunningly simple. Instead of refining the silicon and then building cells, you build the cells first and then refine the silicon.

The process starts with ordinary fine white beach sand, or silicon dioxide. After cell fabrication, the sand is chemically treated. The reaction drives off the oxygen, leaving an almost pure polycrystalline silicon. Most conveniently, any remaining impurities rearrange themselves to form uniformly doped series connected p-n junctions. This process is called *Barfoot layering.* For each centimeter of cell thickness, you get several hundred series p-n junctions, or around 120 volts dc under normal sunlight.

The thickness of the panel determines the voltage and the area, the current. Typical current density yields are four amperes per square meter.

Thanks to Barfoot layering, the efficiency is substantially up over older single-cell designs. The theoretical efficiency is 86.4%, while commercial panels run around 75% and homebrew panels average 40% to 50% with reasonable care. The increase in efficiency comes about since the Barfoot layered panel's work function is a Gaussian distribution around the usual fixed silicon work function, making each layered structure sensitive to a wide range of solar wavelengths.

You can easily build a 100-watt cell. Simply take an ordinary metal cookie sheet, and cover it uniformly with a 1-cm thick layer of fine white beach sand. Then cover that with a piece of screening for the front collector, add a protective glass cover, and clamp everything together with large rubber bands, bungee cords, or something similar.

To do your final chemical refinement, carefully remove the glass cover and spray the sand with two liters of 3,7 Dimethylpentadecon-2-ol Propionate, available from *Webb Chemical Supply, Bigelow,* and others. An ordinary window cleaner bottle makes a handy spray source. Reaction time is four hours.

Since the reaction is photoisentropic, it should be done under magenta safelight, such as with an *Aztec* KK-225 source.

The front terminal is positive, and the greatest output will be obtained when the panel is pointed due south at an elevation of your latitude plus 10 degrees.

Note that this is a high-voltage panel; so be extremely careful with electrical safety.

* * *

How can I save on my power bills?

There have been lots of highly illegal schemes for bypassing power meters, drawing half-wave dc out of the line, etc. Not only are these blatantly illegal, but many of them can also actually damage a power transformer or other utility equipment, leaving you with liability for a monumental repair bill.

There is instead a very simple and legal way to reduce your power. What you do is absorb the reactive power generated by other users on the power system. You can absorb this reactive power by drawing it in 180° phase-opposition. Since the utility's line losses actually go down when you do this, all you are doing is "correcting" the inefficiency of other users on the line. Their loss is your gain.

Typically, most heavy electrical uses involve a coil of some sort, most often an electrical motor. This causes the *power factor* of the line to deviate from unity, and a circulating reactive power component results. To absorb this reactive power component, you want to present an apparently capacitive load to your utility.

The only tricky part is getting any reactive power through a power meter, since the meter only measures the real, or in-phase, component of power use. Some very hairy math appeared a while back in the *Humboldt Transactions on Electronic Mathematic Theory,* (Issue 45, Volume xviii, pp. 1174 through 1193). The math described a process of *enharmonic convolution.* What enharmonic convolution does is show the way to grab reactive power at a leading or lagging 90° phase angle, time delay it a quarter cycle, and then feed it into the load as real in-phase power.

A machine or a circuit to handle enharmonic convolution is called a *nutator.* A build-it-yourself nutator using modern components is a very involved project. Fortunately, obsolete military AN-BBL-51 rotating nutators have recently been dumped on the surplus market.

In fact there's a glut of them, since the military has recently undergone a total rethinking on their entire BBL program. You'll find these stacked in the aisles at such places as *Jan's MIL Ends, Chedeski & Escudilla,* or *Atascotia Surplus.* Cost runs around $17 to $22 each, so the usual payback period on these is around two to three weeks.

Even when stripped for parts, the AN-BBL-51 rotating nutator is a real bargain. There's over three pounds of silver in the slip rings alone, plus the mercury and platinum in the commulating assembly.

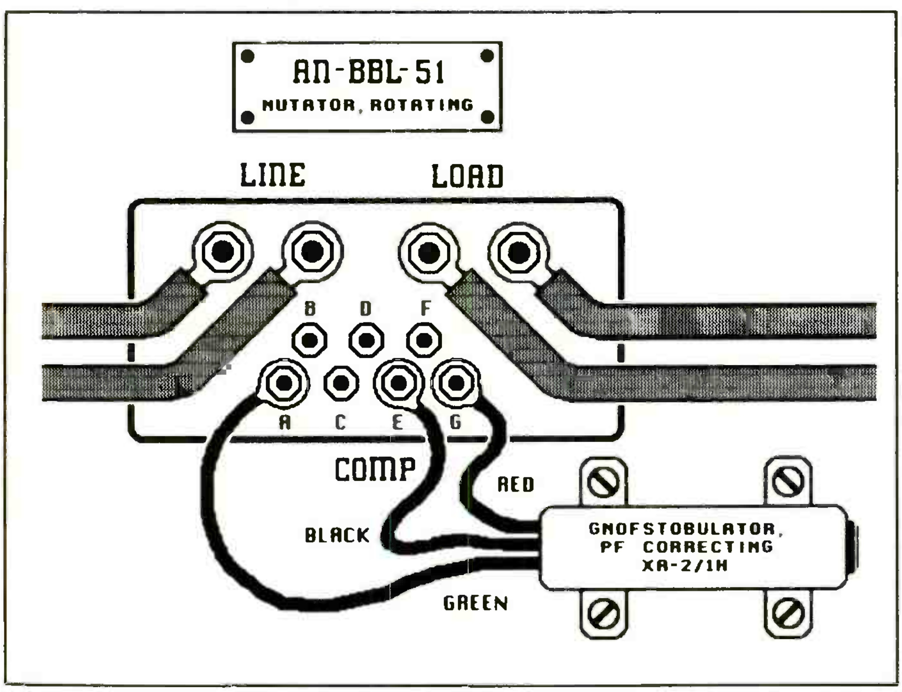
Figure 2 shows the usual connections to the AN-BBL-51. A correcting gnofstobulator should be added as shown. Be extremely careful to get the leads routed to the proper compensation terminals. This part is usually available for under a dollar from the same surplus houses.

Your power savings will depend on how many inefficent users of reactive power are on the line at any one time. Naturally, the fewer nutators on line, the more your individual savings will be.

Be sure to use heavy-gauge wire and observe all the usual safety precautions involved with ac house wiring.

* * *

Fig. 2. Be sure to connect the power factor correcting gnofstobulator to the AN-BBL-51 rotating nutator exactly as shown in this drawing.



I built the* Modern Electronics *mass teleportation system (April 84, pp. 45-52), and used it to phone my girlfriend to Petaluma, California. She got there all right, only now she claims she is left-handed and two inches shorter. Did I use the wrong baud rate?

You idiot! I told you no less than *seven* places in the original article to *always* use the FIXED settings and *always* make a backup copy when you are teleporting live objects.

Figure 3 shows the front panel of the S-100 version of the mass teleporter. Without a backup copy, there is no way you can get her back to her exact old height, but here is what you can try.

First, set your receiving unit to the FIXED position. Then very carefully have her set the transmission unit in Petaluma to VARIABLE.

Set the vertical control to around 106% positive polarity. This should get her back up to size, more or less. Set the horizontal control to 100% but use negative polarity. This should cure the left-handedness. Finally, set the depth control to

HARDWARE HACKER . . .

exactly 100% and positive polarity. Then have here teleport herself back.

In the future, be sure to have both the transmission unit and the receiving unit set to FIXED when teleporting live cargo. As to the baud rate, all this affects is the transmission time. The higher baud rates are, of course, cheaper since the phone line is not tied up as long during the teleportation operation.

By the way, the airline's class action against unfair business practices suit on this is now in the docket of the 5th circuit court of appeals. An unfavorable decision here could severely limit the unrestricted use of mass teleportation systems for casual business travel. Regulation would seem imminient.

If you feel you should have unrestricted free access to use of mass teleportion devices without regulation or tariff, write your senator and congressperson and urge them that the current teleportation bill be soundly defeated.

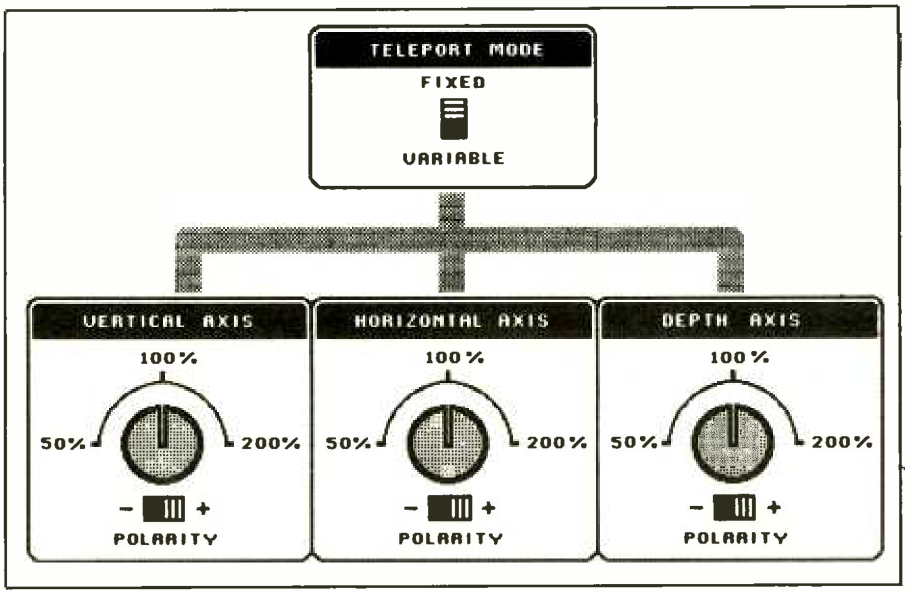


Fig. 3. Mass teleportation system's front panel. FIXED *mode* must *be used when teleporting live objects. Available in S-100, Apple and IBM versions.*

* * *

What is CP/M?

An orphanage of last resort for homeless or otherwise destitute computer software.

* * *

How can I avoid accidental resets?

Most personal computers have gotten much better about the location and use of their RESET keys to minimize inadvertent hits that can blow up a program and ruin days of work. But there is still the human factor, where forcing resets gets to be a habit, no matter how complex the reset sequence is made. You can still do the reset sequence without thinking about it, and you end up in deep trouble.

Elden Inc. has a new product called the INSTA-SNOP. This simply and elegantly solves the problem of inadvertent hits of the RESET key. The mechanism is shown in Fig. 4. It fits directly over the RESET key. An alternate base plate is available for side mounting RESET buttons.

There are two styles available, differing in the size of the opening through the restrainer plate. Their -2 model allows only two resets per user, while the -10 allows 10.

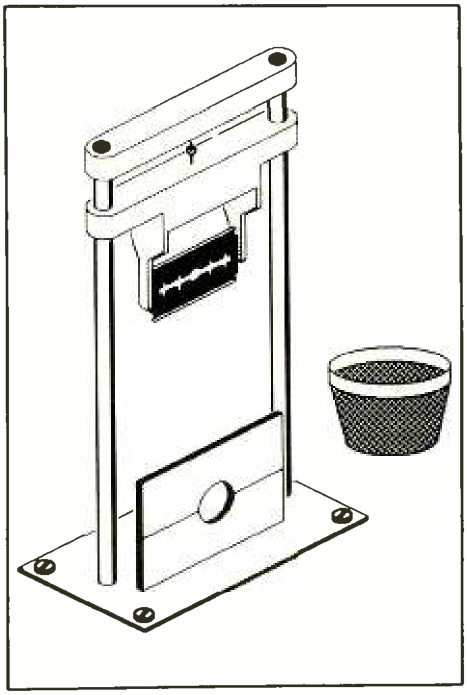


Fig. 4. The INSTA-SNOP™ from elden virtually eliminates accidental hitting of a microcomputer's RESET *key.*

The learning period is said to be extremely short.

There was at one time some problem with OSHA approval for this device, owing to the potential for splinters on the wicker basket. A Teflon top edge has been added to the basket, eliminating this problem. The INSTA-SNOP now meets all applicable federal safety standards for devices of this type.

* * *

After seeing a not-so-recent horror movie, my kid brother claims he is possessed by demons. Is there an electronic cure I can try?

Your brother's cure should be simple. Most any hex inverter should work. If it is a low-power spell, try the CMOS 4069. If that doesn't hack it, step up to the higher-power 74LS04. These cost around a quarter from most advertisers right here in the back of *Modern Electronics.*

That just about wraps up this April's Hardware Hacker. Don will be back next month, and I may or may not be able to see you in a year or so. Depending on whether I can get out again for a while. Till then . . . April fool!—*Marica.* **ME**

SOFTWARE FOCUS

A look at a pair of home finance software packages

By Art Salsberg

Home computer makers have long touted their machines as mini financial productivity tools. We tried out two leading software packages in this genre to see how useful they are: "J. K. Lasser's Your Income Tax" and Andrew Tobias's "Managing Your Money."

"J. K. Lasser's Your Income Tax"/ Simon & Schuster, Inc./One double-sided 5¼" disk/For IBM PC, PC XT, PC*jr*/ $79.95. The income tax deadline is here, though this is written in mid-January. Such are the magazine lead times we must work with. Nonetheless, for you late-birds and for tax planning work, this income tax software could well wind up in your software library. Also, I'm told that buyers can get the following year's updated disk at a discount price.

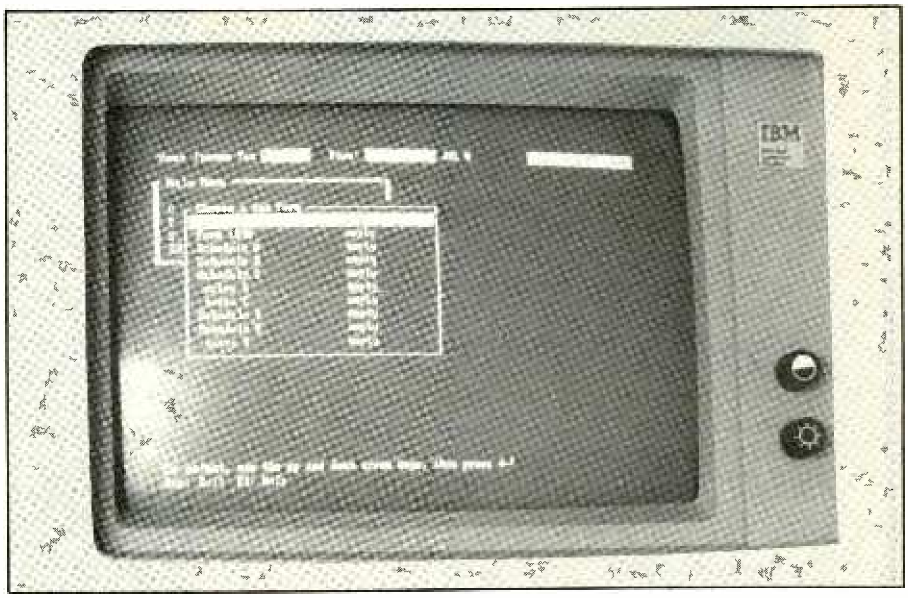
Publishers Simon & Schuster have been producing J. K. Lasser's income tax guides for almost half a century. Now armed with a software divisions, the company developed a single-disk package that includes its best-selling, $6.95 text.

Contained in a 10" × 12½" hardcover binder are the disk, softcover text, and a bound-in 46-page operating guide, making for an attractive package. Nice, but 12½" is too tall to fit on a typical bookshelf, where many people like myself store their software binder manuals.

At least 128K of memory is required, which is no problem for IBM (or compatible) computer owners today. Only one 360K disk drive is needed. A hard disk is supported, too, as is color.

Next Month

Modern Electronics will take a hands-on look at a pair of computer software packages that teach users how to decode Morse Code and how to type. Both feature interesting drills that will surely improve speed and accuracy as you progress. They're fun to use, too.



J. K. Lasser's Your Income Tax program emulates a variety of tax forms so that they can be printed directly on actual forms.

The software makes good use of menus and guides the user by the hand. The starting point is a Main Menu from which a Questionnaire must be chosen before selecting other forms. Once this is done, appropriate forms are selected by moving a highlight bar to the one you wish to use and pressing the Return key on your computer's keyboard.

Each form emulates the IRS's tax form, so filling in the spaces is in preparation for printing out on IRS blank income tax forms. The program automatically shifts to the next space to be filled in when you finish the previous area and enter it by pressing "Return."

The program makes good use of the computer's function keys, including "Help," Calculator," "Compute," and "Go To Key" keys. The latter is a useful time-saver when working on the major tax form, Form 1040, allowing you to move directly to other forms while in the middle of it without using Save commands, returning to the Main Menu, and then accessing another form. Information entered on other forms are automatically transferred to appropriate lines of the 1040 form.

Also helpful are on-screen status lines, which includes reference to the accompanying book; instruction line; and a function-key line.

The software gives you 13 forms and 10 schedules to choose from. You should check the actual blank forms from the IRS, upon which you should have the material printed, to make sure there aren't any changes.

Beyond making out your annual federal income tax forms, the software here includes a tax planner that enables you to choose a number of alternative ways to figure out your taxes and to compare them in order to select the one that will yield the lowest tax bite. Using the system, the program can calculate alternatives and be printed in a single printout.

This is a nice, useful program, especially made so by reference to the authoritative tax guide book that accompanies the package. All the essence of preparing income tax forms could be done by hand and pocket calculator, of course, but it's all so much neater and fun to use one's computer. The automatic calculations and the discipline of it all is a welcome assist.

This federal income tax program will likely be a friendly addition to one's software library. According to J. K. Lasser, it's tax deductible, too. To use it as an all-year-around tax planner, though, you need a money management program such as "J. K. Lasser's Your Money Manager" or . . . .

"Managing Your Money"/Micro Education Corporation of America (MECA)/ Three double-sided 5¼" disks/For IBM PC, XT, AT, with 128K min., and PC*jr* with 256K/ $199.

Andrew Tobias, who helped develop this program, set its user requirements, and wrote the text, followed the maxim, "Keep it simple, stupid." It works well, holding the user by the hand as he moves him through the program, allowing for errors to occur without fouling up the data. As a result, a new computer user filled with fear can blunder all he wants without destroying anything.

The program is actually a host of programs that work together. Making full use of the computer's function keys, pressing the appropriate one from a choice given in the menu on the video monitor brings up the one selected. This might be Budget and Checkbook, Income Tax Estimator, Insurance Planning, Financial Calculator, Portfolio Manager, or Your Net Worth. Other choices are a Reminder Pad, Index, Hello New User, and Leave.

Submenus within each one guide you along painlessly. When figures are entered into the checkbook program, they are *automatically* transferred to the other programs. Consequently, every program section is always up to date without the user doing a thing to make it happen. Now that's improved productivity!

Each section or chapter is organized for breadth and depth financial work. This could be calculating a bond's yield, projected rates of return on different investments, loan analysis and organization, etc.

Also particularly noteworthy is the Reminder Pad program, a very convenient tickler system for important reminders such as appointments and birthday dates. You can choose one-time listing or have the reminder logged in so that it recurs the following year. Another useful feature is a built-in calculator that boasts five memory registers.

Color video is supported (including a "flip" program on Disk 1 to switch from a mono to a color monitor should one have both). Printouts are simple to handle, as well. Moreover, more than one person can use the program. Just copy disks (disks 2 and 3) and mark the label with the user's name so that there aren't any mixups. Disk 1 is used as the "ignition" key, as the brief operating manual notes. Backups of this disk cannot be made since it's copy protected. MECA charges $24.95 for a backup copy when this amount is sent in with the program's warranty card. Otherwise, you have to live with a three-month damaged disk limited warranty.

In sum, this is an excellent home financial program, deserving its high-popularity status. It's easy as pie to use, there are lots of reminders to save work before leaving the program, and plenty of help assists at hand. No one who can read should have any difficulty working with the program, therefore. If your computer and printer have graphics capability, it'll print graphs, too. **ME**

International Shortwave Programs

By Glenn Hauser

International shortwave broadcast transmission frequencies and times are muddied by changes that are made here and there. Compounding this are new transmissions that crop up and programs that change. Here are the latest SW maneuverings around the world.

Belize. The Voice of America has reached an agreement to set up a mediumwave relay here. Besides the new Costa Rican relay on 930, VOA plans eight or nine more MW relays throughout Central America and the Caribbean, to blanket the region and make VOA audible anywhere on ordinary AM radios. Meanwhile, we can hear Radio Belize on 830 and 3285 kHz, but not without effort.

Bhutan. Another installment for the dreamers: Prodyut Banerjee in Calcutta reports that NYAB's Sunday program in English at 0830-0900 UTC, nominally on 7040 kHz, has been trying different unannounced frequencies, probably to escape interference, such as 6970, 6895, 7170. If you hear an oriental station on 3395 during the other program, Wed. & Sat. 1330-1400, it's more likely Indonesia.

Botswana. Radio Botswana has obtained some new transmitters, and put them on different frequencies. Replacing 4848 kHz is 4820, well heard depending on Latin American interference, until 2200 and from before 0400.

Canada. Although parent organization CBC has suffered a $75-million budget cut, Radio Canada International's share turned out to be only $670,000. There will be some staff reductions and less variety in programming to different target areas, but RCI's immediate future seems secure. However, in the *Financial Post,* Andrew Cohen reported, "If RCI has to make cuts, broadcasts to the U.S. and the Caribbean will be dropped." The cuts facing domestic CBC are far more serious—1,150 of the 12,000 staff were to lose their jobs, with a considerable impact on programming and facilities.

"Ideas," the last week of March at 9:05 pm local time on CBC Radio (AM and in some places FM), planned a four-parter on Aldous Huxley: Perceptions and Prophecies, Mar. 24-27; an international sound feature about the life of a peasant in Croatia, Mar. 28.

China. Each year, Radio Beijing distributes a beautiful free calendar to its listeners. The 1985 edition has full-color photos of wildlife and a set of smaller shots showing station activities. The winter morning channel of 6160 at 1200 UTC was replaced by 6200, both subject to Latin American interference.

Colombia. The Amazon frontier area has spawned some interesting new shortwave stations. In the remote northeast corner of the country, an outlet identifying only as "CARACOL Carreno" has appeared on 5936-5937 kHz, audible around 1100 and until 2400 or later. Were it not for the Colombian national anthem, and the fact that CARACOL is a major Colombian network, it could easily be mistaken for a Venezuelan station, since it also serves and frequently mentions nearby Puerto Ayacucho. Then it shifted to 5940.5, as monitored by Ernie Behr in Ontario.

Cuba. In another unexpected development, the main domestic network, Radio Rebelde, has put on a deliberate shortwave outlet, 5025 kHz, seemingly 24 hours. This allows listeners far afield to witness its "new style" of a rapid pace and lots of U.S. music, designed to keep young Cubans tuned to it instead of Radio Marti. Rebelde had often been reported by mystified listeners on 3540, 3600, 5310, 5400, and other strange frequencies. These are harmonics, of an unusually high order, from transmitters on 590 and 600 kHz.

Dominican Republic. Radio Santiago, which formerly varied around the 6-MHz band, decided to try 9 MHz instead—usually around 9778 kHz, best heard in the daytime when interference is lower. There's an hour-long "Noti-tiempo" newscast, replete with doorbells relayed from Radio Comercial in Santo Domingo, at 1630.

Ecuador. Not only Greece, but HCJB decided to go out-of-band above 6.2 MHz; evening broadcasts in European languages mixed with Greece on 6205, while English at 0700 was in the clear. Due to declining sunspot counts, the 13-meter-band channel of 21477.5 in the daytime was dropped this winter, but might be temporarily revived in the spring. HCJB's monthly "Open Line" call-in program for March was scheduled on the 23rd at 0700 on 6130, 6205, 9655, 9745, 11925; 24th (UTC) at 0200 on 6095, 9745. Friday editions of "Passport" are featuring hour-long specials: Mar. 22, music by Jack Stenekes; Mar. 29, Communism in 1985. Listen at 1900 on 17790, 15295; UTC Sat. 0100 on 15155, 9745; 0530 on 6095, 9745, 11915; 1000 on 11925, 6130.

Grenada. Radio Grenada got a new transmitter from the U.S. and resumed operations on 535 kHz instead of 990; this clear 20-kW channel can be heard widely from sign-on at 1000, or until sign-off at 0200. Of course, sensitive and selective receivers and antennas are required.

Israel. After being turned down by Greece and Turkey, Voice of America formally requested that Israel allow it to build a major new shortwave relay station to reach the USSR, not Arab countries. Despite its poor relations with the Soviet Union, Israel was slow to accept the proposal. Meanwhile, Sen. Paula Hawkins (R.—FL) and Rep. Matthew Rinaldo (R.—NJ) proposed early in the 99th Congress that a "Radio Macabee" program especially for Soviet Jews be established under the auspices of Radio Liberty.

Paraguay. Unlike its neighboring countries, shortwave stations in Paraguay are scarce, but thanks to a 100-kilowatt transmitter, Radio Nacional is easy to hear on 9734.4 kHz—at least during breaks in usage of 9735 by the even more powerful Deutsche Welle relay on Antigua. Reception is best in the morning at 0930-0955, 1040-1055, and perhaps from 1130. Also check around 0150. You'll probably hear some nice Paraguayan folk music on the harp, and even when DW is on, the heterodyne from Asuncion can tantalize you.

Pennsylvania seems like a separate country since, unlike many other states, it prohibits prison inmates from listening to shortwave broadcasts. The policy seems to result from an old-fashioned misunderstanding of SW—fear that inmates will somehow transmit with a receiver, or overhear police calls, the latter actually on vhf. A long campaign continues to try to change this policy; letters asserting the harmlessness of SWLing, and its value in rehabilitation, may be sent to Rep. Matthew Ryan, 1 South Oliver St., Media, PA 19063.

Portugal. Radio Portugal had to make some cuts in 1985 in order to stay within its budget. Foreign-language broadcasts were reduced to Mon.-Fri. only, and English to North America was retimed to 0030-0100 (for the east, replacing French) on 9560; 0300-0330 (for the west, replacing 0530-0600) on 6095. Portuguese transmissions remained intact, but Spanish was dropped completely, to the dismay of director Martim da Silveira; we had the pleasure of meeting him and two of the English announcers, Joe Conefrey and Winnie d'Almeida, during a recent visit to Lisbon.

Syria. It's not every month—indeed not every year—that another country starts broadcasting in English to North America. But Damascus Radio did so in mid-January, at 1200-1300 on 17510, though another hour for Europe at 2000 on 11685 may come in better in central and western North America. Abrupt frequency changes are quite possible.

U.S.A. KCBI, Dallas, Texas, began testing on the air Dec. 24, with tones and IDs requesting reports on 11790 kHz, at various times between 1800 and 2200. Numbered QSL cards were issued to early reporters. Tom Gavaras in Minnesota caught them Dec. 26 at 1920-1935. Full-power tests began Jan. 8, but further work on the modulation section was needed, and regular programming was expected to be delayed until February or March. Although frequencies could change, the schedule was expected to include First Baptist Church services Suns. 1645-1800 on 11905; and a Mon.-Fri. 1800-1900 call-in on 11790 (simulcast with FM), "Today in Dallas." Other programming until 2200, and at 0000-0400 on 11870 or 11790 would be separate from FM. KCBI promises that its shortwave listeners will be spared the 3-day annual fund-raising "sharathon" that supports the FM station. The transmitter site is 60 miles from the studio; south of Denton, between Frisco and Prosper, Texas.

NDXE, another new shortwave station, in Opelika, Alabama, is expected to be on the air in June, but has already generated publicity by making a pledge to emphasize sound quality, and be the first station to apply AM stereo to shortwave, using the Kahn/Hazeltine sideband system. NDXE plans to emphasize sports programming, but is already asking potential listeners for comments on programming, to: NDXE, Box 569, Opelika, AL 36801.

WRNO, New Orleans, has been carrying a highly political program, but you might overlook it among the rock music and preachers unless you understand Farsi. "Radio Voice of Liberation" airs UTC Mons. at 0000 on 9852.5.

For about three weeks last November, Yonkers, New York had its own radio station, "All-Wave 1622," KPF941 on 1622 kHz. Licensed as a remote-pickup unit, it briefly stood up to the FCC by operating as a local broadcast station. Bruce Quinn, who operated AM/FM/SW pirate Jolly Roger Radio in Bloomington, IN for many years, has decided to apply for a legal FM outlet in Delphi. The call? WXJR.

USSR. Radio Tashkent, Uzbekistan, often makes it over the pole to North America during its English broadcasts toward India at 1200-1230 or 1400-1430. Winter frequencies of 11785, 9600, 9540, 5985 and 5945 normally change in April to the summer set of 15460, 11925, 9715, 9650, 6025. Content of the two broadcasts differs; the early one is heard better in the east, including: Mon., Muslims of the Soviet East; Tue., Youth Programme; Wed., Life in the Village; Thu., Musical Programme; Sun. after 2nd Sat., DX Programme; last Sun., Salom Aleikum Listener's Club.

For a source list of additional reading about shortwave listening, send a self-addressed stamped envelope, and enclose another stamp, to Glenn Hauser, Box 490756-E, Ft. Lauderdale, FL 33349. ME

BOOK REVIEWS

The latest technical books and literature in the electronics and computer field.

Onmi Complete Catalog Of Computer Software edited by Owen Davies. (Collier/Macmillan; 417 pages; $24.95 hard cover, $13.95 soft cover.)

Though this book is large-format and contains a goodly number of pages in it, the "complete" in its title is misleading. Lacking coverage of such popular software packages as Lotus 1-2-3 and Peachtext, to name just two, as well as newer software such as dBase III, it is hardly "complete." But what it does cover, it covers well. The Catalog is actually a relatively comprehensive alphabetical listing, according to category, of various types of software packages for Apple, Atari, Commodore, IBM, Radio Shack and other popular personal computers. Each entry is accompanied by a crisp, informative description and a capsule "review" of the package. Each entry also specifies the computer(s) for which the product was written, hardware (and software where applicable) requirements, name of originating software house, and suggested retail price. The categories make up different chapters, such as Accounting, Databases, Graphics, Spreadsheets, Word Processing, Entertainment, etc. There are 22 categories (chapters) in all, including two titled Freeware and Disk Magazines. At the back of the book are a glossary of technical computer terms and a directory of software firms with addresses and telephone numbers.

The Hidden Signal On Satellite TV by T. P. Harrington & Bob Cooper Jr. (Universal Electronics; soft cover; 180 pages; $14.95 plus $.200 P&H.)

Written specifically for the satellite communications trade, this is said to be the first book that completely covers the entire field of non-video satellite services carried on domestic satellites. Its focus is on stereo subcarriers, telephone channels, world news and press services, teletext and other VBI systems, single channel per carrier (SCPC) systems, and other data systems. The book deals with all phases of this side of the satellite business. Coverage includes the systems, how they work, who uses them, how signals are received, and how the services can be utilized. The easy-to-understand text is supported by photos, diagrams, and tables.

The Microcomputer User's Guide To Information Online by Carol Hansen. (Hayden Book Co.; soft cover; 240 pages; $18.95.)

Large databases, electronic bulletin boards, and other remote services that continue to make personal computing more useful are the subject of this book. To access them, you must know what and where they are, how to connect your computer to them, and what to do to become a subscriber. This guide tells you about more than 100 databases you can access for home, business, science, news, education, and document-delivery uses. In down-to-earth terms, it explains how you can get started and gives information on costs and vendor publications. Step-by-step instructions are provided for using on-line applications to send mail, talk to other users "tuned" into a network, compute, and program. A complete examination of how to perform a search, including examples, strategy hints, and how to download data are covered. New Lockheed and BRS databases that use simplified command languages and newer equipment and software for simpler searching, including UserKit and Scimate, are also covered. Appendices list major vendors and networks, major databases, selected equipment manufacturers, and selected bulletin boards.

NEW LITERATURE

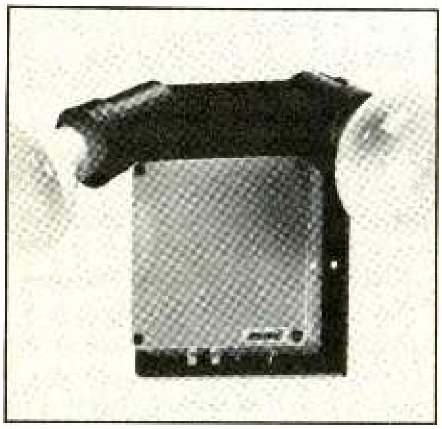
Parts Cross-References. RCA Distributor and Special Products Division has announced publication of updated versions of its RCA Drawing Number to Stock Number Cross Reference (Form 1F6932) and Replacement Parts For Video Cassette Recorder Instruments Cross Reference (Form 1F6627). Form 1F6932 covers parts for all RCA consumer instruments except VCRs and cameras. Form 1F6627 covers replacement parts for VCR instruments. Both publications are available from authorized RCA parts distributors.

Software Protection Devices Catalog. Protection and interference control products are presented in a new 40-page catalog from Electronic Specialists. Listed and described are ac line-voltage regulators and conditioners, modem and telephone-line surge suppressors, and equipment isolators and filter/supressors. Typical software protection and interference problems are described, along with suggested solutions. The catalog also describes applications for high-tech equipment protection and interference control. For a copy of Catalog No. 841, write to: Electronic Specialists, Inc., 171 S. Main St., P.O. Box 389, Natick, MA 01760 or call 800-225-4876.

Home Satellite TV Booklet. "Tuning In To Home Satellite TV" is a 56-page booklet from CommTek Publishing Co. that explains the technology, programming and advantages of satellite TV. In its third edition, the newly revised color brochure, prepared by the editors of *Satellite Orbit* magazine is written in layman's terms. It gives a brief history of satellites and an explanation of the equipment a consumer needs to receive the TV signals they transmit. Included are a question-and-answer section and a glossary of terms. A 32-page sections lists a typical month's programming on 123 satellite channels available to the home viewer. You can obtain a copy of the booklet by sending $1.00 (to cover postage and handling) to: Satellite Orbit, CommTek Publishing Co., 418 N. River., P.O. Box 1700, Dept. 02-DLR, Hailey, ID 83333.

NEW PRODUCTS . . .

(from page 13)



el D12L switch detects motion inside a 30′×30′ (adjustable) area. When it does, it switches on and remains on as long as the motion continues. Once motion is no longer detected, a preset time delay switches off the power. Both detection pattern and delay time are user adjustable. The switch offers three operating modes—manual, automatc, and darkness-only.

The motion detector is housed inside a weather-resistant enclosure and is unaffected by humidity, temperature, air movement, and noise, which makes it safe for outdoor use. The device automatically switches loads up to 1000 watts at 117 volts ac. Standby power consumption is only 7 watts. The Model D12L is equipped with a pair of lamp holders. It's also available as the Model D12, sans lamp holders.

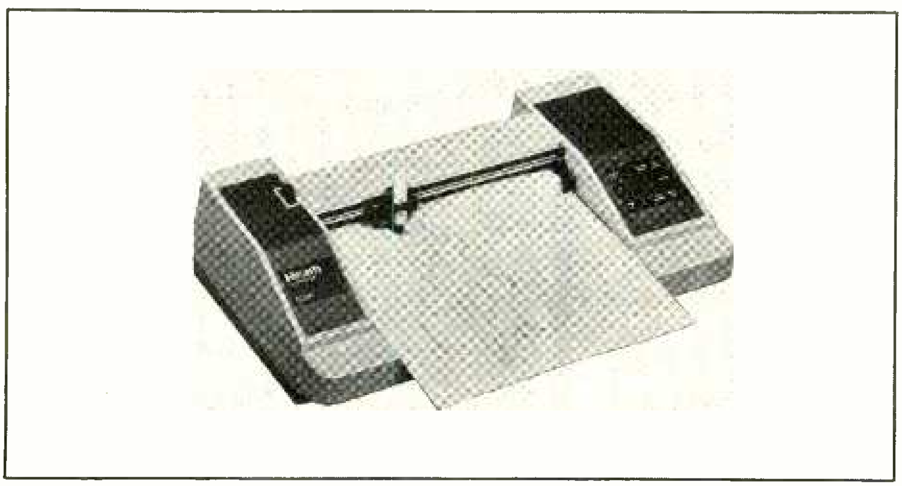
CIRCLE 68 ON FREE INFORMATION CARD

Kit Version Of A Popular X-Y Plotter

Heath's new digital X-Y plotter, the Model IR-5208, is the kit version of the popular Sweet-P Plotter. The single-pen IR-5280 draws virtually every graphics format, including pie charts, bargraphs, straight- and curved-line graphs, illustrations, and alphanumeric labeling on plain bond paper and transparency material. Line segments are said to be accurate to 0.004″ and writing speed is a maximum of 6″ per second.

Compact and light enough in weight to be carried in a briefcase, the plotter can be connected to the parallel port of almost any computer. It is operated by simple commands entered into the computer. A software support package is available for the plotter for use with the entire line of Heath/Zenith computers and the IBM PC and compatibles. Included in the kit is a parallel interface cable and four colored pens. $349.95.

CIRCLE 80 ON FREE INFORMATION CARD



determined. Driving signals are then sent to a pair of audio amplifiers that, in turn, drive speakers.

•*SECAM Chroma Processor*. The SPU2220 SECAM chroma processor (French for FM video and AM audio) is not applicale in this setup.

•*Teletext Processor*. The TPU 2700 isn't in the Toshiba Model CZ2094, though it may be included in future models. It will certainly be included in at least one competitive receiver/monitor soon to come into the marketplace and, therefore, is worth a brief review. The Level-1 Teletext processor is a 40-pin VLSI NMOS device that offers ghost compensation for undesirable secondary images. It uses a 7-bit Gray code digitized video signal, stores up to eight pages of text, will underline, has automatic language-dependent character selection, and can switch between PAL and SECAM (note the absence of U.S. NTSC here). An external 64K-bit dynamic RAM (DRAM) stores text in 2-, 4-, or 8-page increments.

How It Fared

When compared with the analog competition, the Model CZ2094 revealed generally better performance on the lab test bench than we've customarily obtained in the past. Most of the story is unfolded in the spectrum analyzer/oscilloscope photos shown elsewhere in this report.

Ever since Lester got his modem, he's communicated with everyone in the continental U.S. except me!

On the bench, this remarkable color TV receiver/monitor gave pretty good readings in most important areas. Luminance and chroma signal-to-noise (S/N) ratio, for example, was 43 dB, while the high-frequency luminance bandpass was 4.2 MHz wide and the chroma vector dis play was passable. In general, powe supply regulation was superior t. outstanding at almost 100% in both the low- and high-voltage sections. The measured 90% dc restoration figure is also superior. Colorbar registration was exceptional. Pictures were snappy all the way, thanks to the CRT's superb edge-to-edge focusing and the 99.9% RGB convergence.

Audio, too, comes in for its fair share of praise. Stereo separation between the left and right channels coming from the system's built-in stereo amplifier measured a reasonably good 40 dB. Sound from the two built-in speaker drivers was pleasantly "wide" ranging, responding out to 10 kHz at −12 dB. It may not be what you've become accustomed to from your hi-fi system, but it's certainly far better than what's usually obtainable from built-in speakers.

User Comment

One of the maxims of the video marketplace is that good color TV receivers, whether digital or analog, aren't exactly "economy" priced. The Toshiba Model CZ2094 color TV receiver/monitor, at $1199, fulfills the rule, though for a hot new product with the latest in digital video technology, it's really reasonably priced. This is a deluxe receiver/monitor all the way, designed to meet your needs now and for some time to come.

How do we feel about the Model CZ2094? Well, considering that Toshiba has brought to market a *finished* product, we give it an AAA for effort. In terms of features offered and execution, there's no doubt in our minds that the Model CZ2094 deserves a 9+. ME

Booming World of Consumer Electronics *(from page 27)*

Mitsubishi displayed two car CD systems, saying both will be ready for dealer delivery in May. Both units use its CD-100 CD player. Its System I is coupled to the company's CV-232 50-watt/channel graphic equalizer/amplifier, a $600 package. System II teams the CD player with the CZ-741 receiver and four-channel 100-watt amp. The players use a multi-color LCD display. Pioneer's $600 CD player, the new CEX-P1, is said to be compatible with virtually any car stereo system. Readouts for elapsed play time, total play time and remaining time are on a fluorescent display. Tracking error caused by vibration is minimized by computer technology that memorizes the laser beam's position on the disc when a severe bump occurs. The machine comes in two modules: an operating module for the user and a processing module that's installed behind the dash or in another remote location.

We saw some neat auto-sound accessories. One that caught our attention was the Cassetter from Pompano Manufacturing. These are illuminated cassette storage compartments that make it easy to select an album while driving at night. Another was Blaupunkt's stalk-mounted five-band graphic equalizer with four-way speaker control. The $165 device also has LED level display and night-illumination design.

Of course, there were a zillion car stereo units, with electronic tuning models causing the most excitement, as well as power amp boosters, graphic equalizers, and speakers, speakers, and more speakers. And speaking of speakers, don't think that those of you with recreational vehicles were neglected. Alpine unveiled a subwoofer just for you, its model 6490. Using an acoustic-suspension system and a labyrinth opening designed to be directed toward a corner of the vehicle to create a folded-horn effect, its bandwidth is 30 Hz to 500 Hz, with a peak power rating of 150 watts at 1 kHz.

Radar detectors were on hand, of course. Two-piece hideaway ones continued the trend established a few years ago. The feature being boasted about more than any others appeared to be locking out false signals. Controlonics calls it the "Pollution Solution" on its Whistler detectors; Dynascan's Cobra Group says it about its "Trapshooter" detectors, calling it "Lockout"; and Uniden says it about their RD55 and RD95 radar detectors, calling it E.D.I.T. (electronics data interference terminator).

Citizens Band radios are not dead at all, it seems, since a bevy of manufacturers introduced new CB models, including Uniden, Dynascan, and Midland, among others.

More than ever, it's apparent that car theft is a major problem, judging by the great number of auto security devices exhibited. Chapman Security, the company that introduced the first combination hood lock and ignition suppression system (the Chapman-Lok) unveiled a hand-held remote control vehicle security device called, "Phazer." The small transmitter, measuring only 2½" × 1¾" × ⅝", sends out an infrared-coded signal so that the user can operate the Chapman system from outside the vehicle. Code-Alarm of Troy, MI announced a micro-size mercury tilt alarm, the MTS-1, that's the size of a quarter. The switch can be mounted with only one screw and uses a flexible metal tab with no mounting bracket to simplify installation.

Next Month

The concluding part of this article will give you further insights to what you can expect to find shortly on dealers' shelves. It will cover newly introduced computers, printers, electronic typewriters, graphics tablets, telephone electronics, electronic music keyboards, electronic health devices, and more. ME

Compulogic RS-232 continued (from page 17)

at PIN 1." No problem. But then the instructions said: "Connect the other end of the power cable to SK-3 or any open connector on the Power Supply PC Board." Oops! The non-Radio Shack power supply that had been installed with my non-Radio Shack disk drives had no open connector! Furthermore, except for mentioning that the red wire of this power cable was +5 volts, the other three wires were not identified.

What to do? Dan, the professional that he is, was not fazed by this. He got a meter, measured a few voltages, drew some conclusions, and spliced some wires. He finished the installation (after struggling a little getting one of the flat cables to mate with a tight plug) and plugged things back together for a test. It worked! It had taken almost two hours, for which I insisted adding to his modest estimate fee.

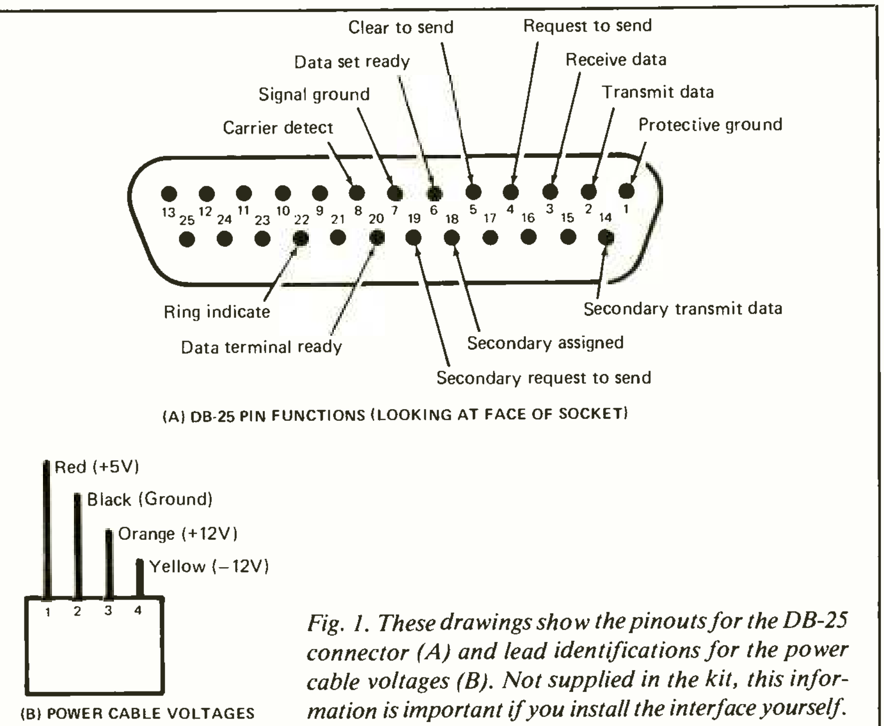


Fig. 1. These drawings show the pinouts for the DB-25 connector (A) and lead identifications for the power cable voltages (B). Not supplied in the kit, this information is important if you install the interface yourself.

Conclusions

Even without the "missing plug" problem caused by my non-standard power supply, it would have to take, for a first installation, at least an hour to digest the instructions and get acquainted with the cables and their routing. If you for some reason did another one soon after, you could probably do it in half the time. CompuLogic people probably can do the job in the claimed 15 minutes, but I think that doing it in less than 15 minutes first time out is an exaggeration.

Other than this, and the lack of pinout information (which is not essential for a normal installation), I'm very pleased with my CompuLogic serial interface. I've been using it extensively for a couple of months and use it regularly on CompuServe. Moreover, I've transmitted about a dozen magazine articles to a CompuServe workspace for retrieval by an editor; uploaded and downloaded files; and used the interface with several different modems at 300 and 1200 baud. I've even used it to upload files from a portable word processor. As a bonus the RS-232 port could also be used to drive a serial printer.

Therefore, for only $69.95 plus $3 shipping and handling, and the "nerve and guts" to install it, you open vast new capabilities for Model III or 4 TRS-80s that don't already have a serial interface installed. I'm certainly glad I added mine!
—Fred Blechman

CIRCLE NO. 117 ON FREE INFORMATION CARD

Kit Report: Heath Model AD-1308 Real-Time Spectrum Analyzer

Last Month, assembly details on the Heath Model AD-1308 real-time audio spectrum analyzer and its companion accessories were not included. Since these products are available only in kit form, our assembly experiences are just as germane to the report as the performance details in our product evaluation. Therefore, this month we're including our observations on kit assembly.

Assembling an instrument as complex as Heath's Model AD-1308 real-time spectrum analyzer from a kit is a major task. It's easy to assume, given the products's size, that this is a one- or two-evening kit-building job. Don't you believe it! The complexity of the circuitry belies appearances. It took me 17½ hours to assemble and put the AD-1308 into service. The companion ADA-1308-1 power-supply/rack-mount accessory and AD-1309 pink/white-noise generator took another 4½ and 1¼ hours, respectively, to assemble. So, plan to set aside almost 25 hours to build all three units.

Spectrum Analyzer. Assembly of the AD-1308 isn't really difficult; rather, it's time-consuming. Contained inside the compact plastic cabinet are three major printed-circuit board assemblies. The least time-consuming to wire is the display board, which took me about 2½ hours. Next was the digital board, which accounted for another 5¾ hours. By far the most time-consuming part of the job was wiring the analog board, accounting for yet another 7¼ hours. The remainder of the time spent building the AD-1308 was devoted to so-called "chassis" work and calibration.

No part of assembling the analyzer was particularly difficult, though wiring of the analog board became tedious after a couple of hours. The reason for this is that this board is extremely densely populated, so dense that it's reminiscent of model airplane R/C receivers, even to having the resistors mount on-end. To give you an idea of just how densely populated this board is, it contains more than 320 components, requiring more than 825 solder connections. In contrast, the display and digital boards contain about 110 and 180 components and required some 415 and 575 connections to be soldered.

With almost 2000 solder connections to be made, the AD-1308 is almost as component-busy as a console color TV receiver and even a middle-of-the-line personal computer. But when you're finished assembling the analyzer, you've saved considerably on the price of an equivalent factory-assembled product—assuming you can even find an equivalent analyzer for less than $1000.

To aid in identifying components and to keep wiring errors to a minimum, Heath has arranged small components (resistor, tubular capacitors and diodes) on tape strips in the order in which they're called for in the assembly manual. If this has not been done, I would estimate that you might have had to add up to perhaps three hours to the time required to assemble this kit.

Operational checkout is simple and straightforward. It can be done in about 10 minutes, without the need for test equipment. Instrument alignment was also a simple procedure, requiring only one control in the analyzer to be set. To accomplish this, a dc voltmeter with 0.5% accuracy (a 3½-digit DMM will do nicely) and a dc voltmeter calibrator or a variable dc power supply capable of delivering 628 mV with less than 0.5 mV of hum and noise are needed.

Power Supply/Rack Mount. The Optional Model ADA-1308-1 power-supply/rack-mount accessory is particularly appealing if you have plans to extensively use the AD-1308 for electrical connection to audio equipment and for recharging Ni-Cd cells inside the analyzer. The power supply is designed to allow the analyzer to dock in a cavity, behind a drop-down front panel with a cutout in it that provides access to all analyzer controls and an unrestricted view of the display.

Docking the analyzer inside the power supply bypasses the analyzer's POWER switch and transfers control to the accessory's POWER switch. It also provides a means for recharging the analyzer's batteries, the input and output jacks for connection into an audio system, and the switches for selecting and displaying any combination of the left and right outputs from the audio system.

Assembly of the power supply is accomplished by wiring a single printed-circuit board with 57 components and wire jumpers and soldering 176 connections, plus chassis work. The latter consumes most of the assembly time and is greatly simplified by captive hardware.

Pink/White Noise Generator. The final item that makes up the real-time audio analysis system is the optional Model AD-1309 pink/white-noise generator. This is a very compact and lightweight item that easily stows behind the analyzer inside the power-supply/rack unit.

A single small printed-circuit board accommodates all but the OUTPUT POWER (level) control and the PINK NOISE and WHITE NOISE OUTPUT jacks, which mount directly on the instrument's front panel. There are 82 components that mount on the pc board, including jumpers, accounting for 97 solder connections. Interconnections between the pc board and front-panel components are made with short lengths of hookup wire. A snap-on connector for the 9-volt battery that powers the generator also wires to the board and front-panel power switch on the level control.

General Comments. As an experienced kit builder, I have always been impressed by the quality and lucidity of the Heath assembly manuals. The manuals supplied with these kits are no exception. Now that Heath has taken a no-confusion approach to parts packaging (the taped strips of small components mentioned above), the company has tied up a loose end that neophytes and even experienced kit builders had to struggle with in the past.

—Alexander W. Burawa

CIRCLE NO. 123 ON FREE INFORMATION CARD

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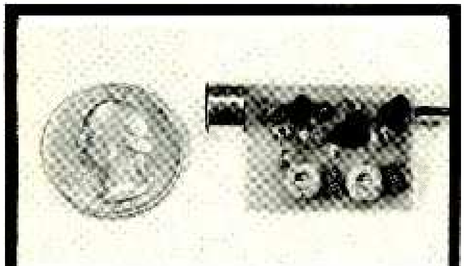

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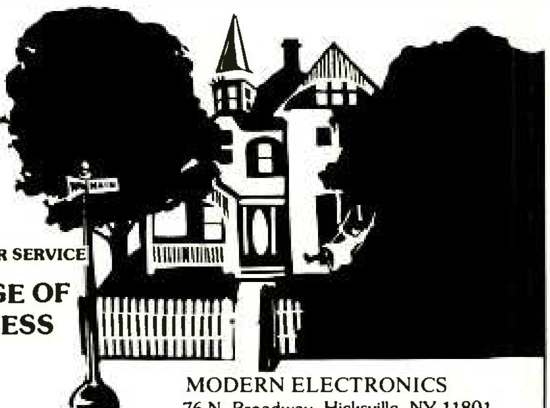

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Circuit Design From Scratch *(from page 73)*

tire circuit, including power supply is pin 2 of the 7805 (see Fig. 5).

Once again, good design practice dictates that bypass capacitors *C1* and *C2* be included in the circuit to minimize noise.

3) Putting It All Together

Now that we have all the elements needed to produce our EPROM tester, let's put them all together into one circuit, as shown in Fig. 6. Note in this schematic diagram that the circuit will be controlled by normally-open pushbutton switch *S1*. Pressing the button on *S1* supplies power to the whole circuit for as long as the switch is held closed.

Because *S1* controls power to all the circuits, instead of just the EPROM, when its button is first pressed, the monostable multivibrator may be triggered once or twice before all voltages stablize at the steady-state levels. Hence, you may see *LED1* flash once or twice when the button is first pressed, even if the EPROM being tested is good. After those first brief flashes, however, if the EPROM is erased and is in good condition, the LED should remain off. Of course, if even one bit in the EPROM is programmed with data, the LED will remain on for as long as *S1* is held closed.

To switch the tester from the 2716 to the 2732 mode, spdt switch *S2* is used. Since power for this tester is drawn only when an EPROM is being tested, battery life is very long. To test battery condition, just press *S1* with no EPROM in the circuit. If the LED is brightly lit, the battery is okay; when the LED starts to dim, change the battery.

To make construction of this project easy, a printed-circuit board is available from the source given in the Parts List.

In Closing

In the first two installments in this series, we led you through the various phases of the design procedure by providing all the information you needed to make your own project. This time around we've introduced you to data sheets and how they are used to help you in your endeavors. In upcoming installments, we'll be taking you deeper into design procedures and practices, building your confidence in designing your own projects from scratch. **ME**

Precision Voltage Sources *(from page 60)*

other manufacturers). Check the linear and power supply IC catalogues from any of the major semiconductor makers for data sheets on other types.

Conclusion

Adjusting the reference source poses another problem. What does one use as a reference? There are several alternatives. For those who are intrepid, take the finished reference source to someone who has a real accurate zillion-digit, multi-kilobuck digital voltmeter and use it as a truth and beauty. For most of us, however, we can adjust the source using a brand new digital voltmeter (or oscilloscope), and then live with any problems that develop. In most cases, we can trust our DMMs (or have them commercially calibrated) so that they can be used to monitor the reference source when calibrating other dc measuring instruments. **ME**

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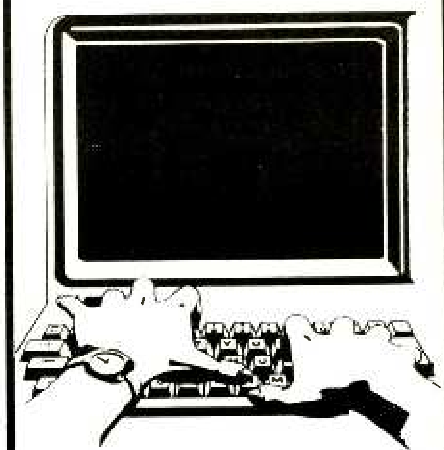

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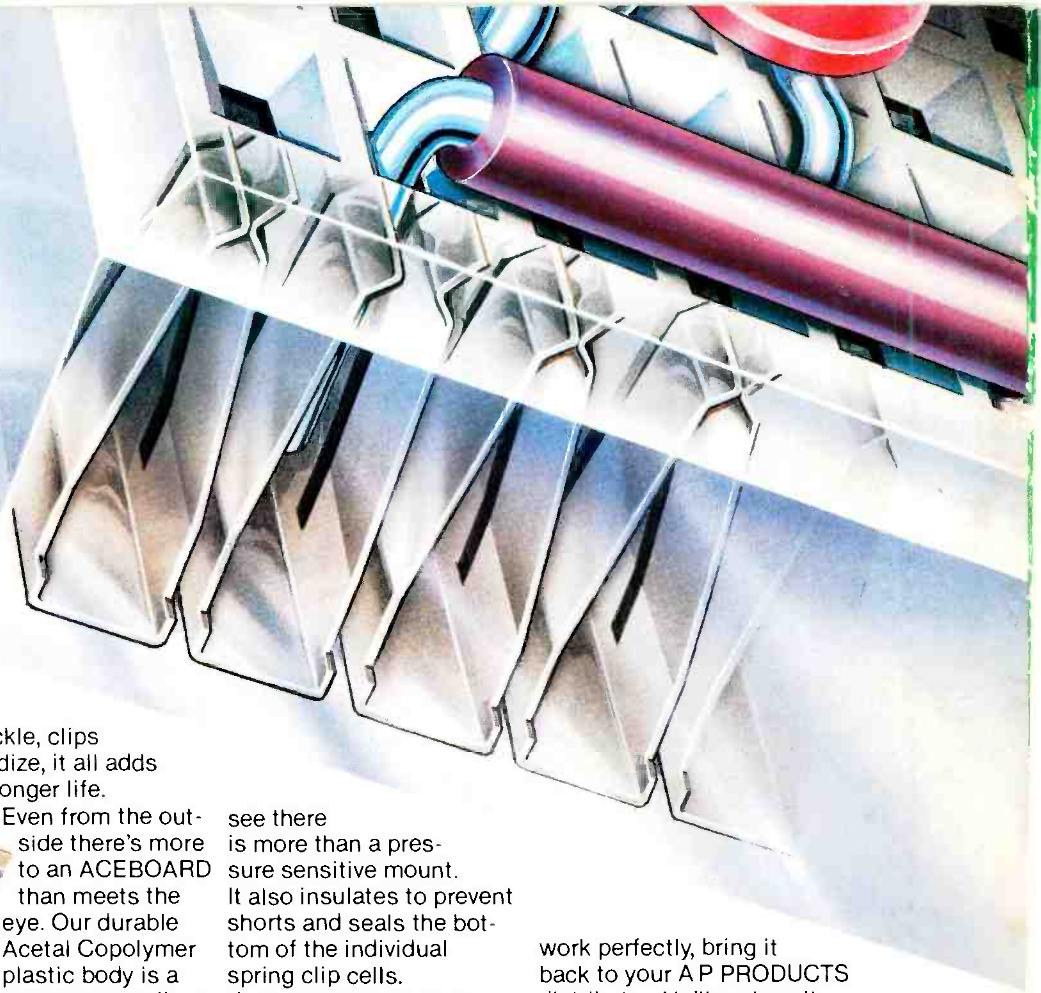

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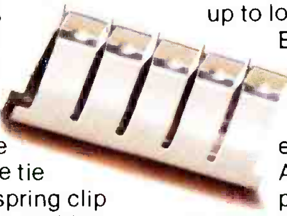

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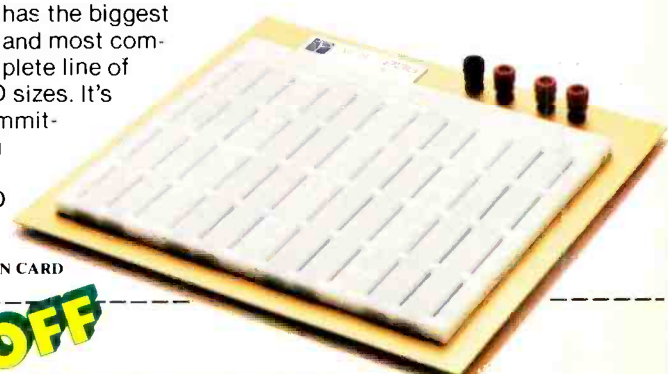

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